JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MAY, 1857.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

On the Cause of the Frequency of Fire occurring on board of Steam Vessels of all Descriptions. By CHAS. H. HASWELL, C. E.

To the Mechanics' Club of the American Institute, New York.

NEW YORK, January 31st, 1857.

In consequence of the frequency of fire occurring on board of steam vessels of all descriptions, I deem it proper to address you upon the subject, for the purpose of inviting your attention thereto, and at the same time submit to your consideration the following recital of the principal causes therefor, and also some observations regarding the proper measures which, in my opinion, should be resorted to, to arrest or remove them.

NEGLECT OF SECURITY AND PROVISIONS AGAINST FIRE ON THE PART OF THE CONSTRUCTORS AND OWNERS OF STEAM VESSELS.

BOILERS.

1. *Boilers with external furnaces*, alike to the ordinary cylindrical boiler of the Western and Southern waters, are supported by iron standards; the sides of the furnaces and the bottoms of the lower flues, being constructed with brick work and mortar beds, and in the construction of this work, care is given more to the general confinement of the fire and flame for the economy of fuel, than it is to guard the vessel from being fired. When boilers of this description are used, even on land, it is impracticable to keep the brick work and bedding permanently free from fissures, whereby fire or sparks may pass out and ignite any inflammable material they may come in contact with; how much more difficult then,

The Treasurer's statement of the receipts and payments for the month of February was read.

The Board of Managers and Standing Committees reported their minutes.

The Actuary reported that the following Standing Committees for the present year, have organized by electing their Chairmen and appointing the times for holding their stated meetings.

Committees.	*Chairmen.*	*Meetings.*
On the Library,	James T. Lukens,	1st Tuesday Evening.
" Exhibitions,	John E. Addicks,	1st Thursday "
" Arts & Manufactures,	James C. Booth,	1st Friday "
" Meteorology,	Alfred L. Kennedy,	2d Monday "
" Science and the Arts,	John C. Cresson,	2d Thursday "
" Meetings,	Washington Jones,	Monday previous to 3d Thursday.

Candidates for membership in the Institute (4) were proposed, and the candidates proposed at the last meeting (4) were duly elected.

Mr. F. Peale exhibited samples of a new valve for which Letters Patent of the U. S. had been granted to him, and explained its construction and form, being an imitation as nearly as possible by human hands of the valves of the arteries and veins of the system.

He stated what he believed were the advantages possessed by these valves, and although applicable to any purpose to which ordinary valves are applied, they are particularly so to elastic and flexible tubes, in which form they were presented to the attention of members of the Institute, and showed that they occupied no more space than the diameter of the tubes in which they were placed, were extremely simple and easy of construction, and therefore economical; that they were not liable to derangement; would bear the roughest treatment, which was exemplified by beating, bending, and even treading upon them, and would work equally well in any position. He also stated, that being made of the same material as the tubes themselves, that is, vulcanized gum elastic, they could not be injured by any agent that would not destroy that material, and finally exhibited the action of the valves in syringes, in a very satisfactory manner.

Mr. Jones submitted the plan of joining the ends of leather belts by means of hooks which was discussed, and samples of the hooks shown. They are made of cast iron wire flattened between rollers, and cut to lengths, when the ends are turned over towards each other. In this state they resemble links of a chain, having the straight part of one side cut away.

When a belt is to be joined, holes are punched at proper distances from the ends, the hooks inserted, and then closed by a blow from a hammer. The plan is a simplification of lacing or joining by wire, and seems to be superior, as the joinings can be made in less time and with less material. When the belt needs shortening the hooks must be cut, and cannot be used again, but the loss is small, as they can be supplied very cheaply.

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BOILERS.

1. *Boilers with external furnaces*, alike to the ordinary cylindrical boiler of the Western and Southern waters, are supported by iron standards; the sides of the furnaces and the bottoms of the lower flues, being constructed with brick work and mortar beds, and in the construction of this work, care is given more to the general confinement of the fire and flame for the economy of fuel, than it is to guard the vessel from being fired. When boilers of this description are used, even on land, it is impracticable to keep the brick work and bedding permanently free from fissures, whereby fire or sparks may pass out and ignite any inflammable material they may come in contact with; how much more difficult then,

must it be to keep brick work free from fissures, when it is subjected to the workings and concussions of a steam vessel.

2. *Boilers with internal furnaces*, alike to the ordinary marine boilers, are frequently constructed without water bottoms, hence, when the fittings of the legs to the bed of the boiler is imperfect, either by neglect in the workmanship, or may become so by the effects of rust, an opening is exposed, whereby fire or sparks may pass out, as in the case just recited.

3. *Boilers, the furnaces of which are fitted with blowers, to afford an artificial draft.*—In this case the pressure of air within the furnace, flues, and pipe, being superior to the external atmosphere, any fissure or hole in any part of the external face of the furnace, the fitting of the legs of the boiler to its bed, (when there is no water-bottom,) the fitting of the man-hole doors or flue-stoppers, and the fitting of the smoke pipe to the chimney, becomes a ready vent to fire or sparks which are driven out with great velocity, when the blast is high, and which falling upon, or adhering to, any inflammable material they may come in contact with, the risk of igniting it, is incurred thereby.

Coverings and protection to boilers.—It is very rare to find that the boilers of any of the Lake, River, or Sound steam vessels, are covered with felt (of hair), for the double purpose of protecting the wood work around them from fire, and for the economy of fuel. This very effective precaution against fire, is scarcely known amongst the class of steamers referred to, whilst its use in the sea-going service is almost universal, the utility of it being recognised, in restricting radiation of heat, from the boiler to the engine room and cabins of the vessel, and in its economy of fuel: although at this time there are many owners of steamships, who pertinaciously refuse to resort to this means of effecting economy of fuel, comfort to the passengers and crew, and of reducing the risk by fire, merely because it involves an immediate expenditure of money, and because the engineers of the vessel, in common with a large majority of the profession, always oppose any means calculated to save life, property, and fuel; consequently they do not urge upon the owners of their vessel, the propriety and necessity of this provision.

As a security against fire from being communicated by an over-heated boiler, a covering of felt is of the first importance—for the reason, that immediately upon its being burned, the peculiar odor of its combustion is readily recognised, the engineer and firemen upon duty at once know that the felt around the boiler is being burned; their attention is forthwith drawn to the circumstance, and if it has arisen from an over-heated boiler, or from fire being communicated through a hole or fissure, it is readily discovered, and remedial measures resorted to.

Covering and protection to wood work around boilers.—In our Lake, River, and Sound steamers, it is very rare to meet with any covering as a protection from heat or fire to the wood work contiguous to a boiler; the neglect of this essential point is so general, as almost to be deserving of being classed as universal, and as the occurrence of fire, originating around a boiler, is not restricted to one cause, but may arise from so great a number, it is difficult to account for the continual neglect of proper precautions upon this point.

The cases in which the wood work around a boiler is exposed to being fired are,

1. When the water in a boiler has been allowed to fall below the flues, the shell and steam drum or chimney, as the case may be, become sufficiently heated by radiation from the superheated steam within, to effect ignition of wood work immediately exposed to it.

2. When water has been allowed to fall below the flues as just referred to, and the occurrence is discovered, it is customary, immediately to haul the fires from out of the furnaces, into the fire room, and when the wood work immediately over and around the fire room is not properly protected, fire is likely to communicate to it, and fires from this cause have frequently occurred.

3. When blowers are used, the fire or sparks that may be blown out through fissures in the furnace doors, ash pits, flue holes, chimney connexions, &c., will readily ignite wood already at a high temperature and quite charred, from having been before exposed to such temperature.

Chimney Jackets and Rooms.—In single decked steamers, when the boiler is below, and the steam chimney is above the main deck, or when the boiler is on the main deck or upon the wheel guards, it is customary in many cases, to cover the chimney or chimneys, as the case may be, with a wooden casing, set off from it but a few inches, and in others to cover it with a sheet iron jacket, in most cases imperfectly made, and in all, insufficiently fitted. In steam vessels with two or more decks, the boiler or boilers being in the hold, the steam chimney and the base of the smoke pipe are commonly enclosed in wood work alone, which is in some cases set at a proper distance from the chimney, to avoid the risk of it being fired by sparks or the continued radiation of heat from it, but the purpose of this space is very frequently negatived, by its being used for the storage of swabs, buckets, brooms, &c., &c.

This wood work, however, is very seldom properly protected, in many cases no protection at all is attempted ; in some a coat of whitewash is laid on, and in others a lining of tin, zinc, or iron, in which the laps of the sheets are laid downwards, as if they were there placed to shed rain or water falling from above, instead of fire arising from below. The tin, and even the zinc, unless well nailed, are too light, and their expansion at high temperatures too great for this purpose: the consequence is, that when subjected to the heat of the smoke pipe, they wrinkle and spring to such a degree, as not only to admit any sparks that may arise up from below, to pass between their laps and under them to the wood, but the sparks are liable to be arrested there by the inequalities of the surfaces, where they are exposed to a draft of air which readily effects an ignition of the wood, and when this is discovered, the presence of these sheets prevents the immediate application of water to the fire underneath them, and before they can be removed, the flame has passed through the joints or crevices of the light wood work around the chimney and boiler, and the whole is in full combustion.

In other cases this wood work around the steam chimney or drum, is placed close to it, precluding the proper circulation of air, and not affording the necessary room wherewith to cover the wood with any material, or even to whitewash it, and when fire is communicated to this work,

fitted by its character and position for ready combustion, it is in the most favorable condition therefor, and when ignited it requires but an instant for it to be developed, beyond the control of the means usually found in steam vessels.

Deck loads.—It is a common occurrence for the main deck of our Coast, Lake, Sound and River steamers to be so encumbered with freight, that not only is a great risk incurred from fire being communicated to the freight when combustible, but in the occurrence of fire, the presence of this freight is an obstruction to the means necessary to be resorted to, to extinguish it.

Store and Tool rooms.—These are other and prolific sources of fire on board of steam vessels, rendered so by their being appropriated to the storing of oils, paints, turpentine, (the latter frequently in packages of glass,) wiping stuff, either of loose hemp or cotton waste, packing yarn, cotton wick, matches, &c., &c., which in a large majority of cases are not properly stowed, but from the carelessness of those who visit these rooms, articles alike to the above recited, are scattered about and constantly exposed to be ignited by the upsetting or falling down of a lamp or candle. In steamers with two decks, the boiler or boilers being below, it is by no means unusual to find a part of the space immediately over the boilers allotted to a store room for the engineers' department, for the reason that being unsuited by its high temperature for ordinary purposes it is not objectionable on that account as an engineers' store room, added to which, it is declared to be very convenient to the engine room, and the propriety of the location is thus confirmed; the result of which practice is, that upon the upsetting of an oil can, or the breaking of a glass vessel containing spirits of turpentine or paint oil, the top and sides of the boiler beneath are flooded with an element of combustion, which rarely if ever fails to cause the destruction of the vessel.

Pumps.—In the construction of an engine for a steam vessel, it is usual to attach an ordinary lifting pump, of a capacity calculated to free the vessel from the drips and vents of water from the engine and boiler, and from the ordinary leaks of the hull. This is also arranged so as to be worked by hand when the engine to which it is attached is not in operation, and it is usual also, to connect to the feed pumps of the boiler, an air vessel by which it may be made to project water, and thus be used as a fire engine, and until the introduction of the independent steam fire engine and bilge pump of H. R. Worthington, within the last ten years, no other means were depended upon to free a steam vessel from water, or furnished it to arrest a fire.

With these details, then, of the numerous causes of fire on board of steam vessels, and of the imperfect means to prevent or arrest them, I now proceed to recapitulate the several causes here referred to, and to suggest such measures as, in my opinion, should be resorted to, by the owners of steam vessels at this time, and builders of them hereafter, by which this class of disasters may, to a great extent, be averted.

Neglect of Security Against Fire.

1. *Boilers with external furnaces* should be supported by iron standards alone. The sheet or plate iron, as the case may be, which encloses

the masonry should be accurately fitted in its joints, and under no circumstances should the wood work around the boilers be allowed to be within one foot of them, their upper surfaces being well covered with felting of hair, and the under side of the wood work immediately over them sheathed with zinc or sheet iron; the nails securing which to be in squares not more than one and a half inches apart, and the laps of the sheets to be secured at every half inch.

2. *Boilers with internal furnaces*, should have water bottoms in order to guard fire from being communicated to their beds through openings therein, and when a natural draft is used for combustion, the exhaustion within the furnaces, flues, and pipe, is such as to cause a current of air to lead into and through any apertures opening to them, and hence fire or sparks are prevented from being emitted through any of the ordinary openings or joints about a boiler; but where a blower is used, the conditions are entirely different. The pressure of air within the furnaces, flues, &c., is so great, that fire, sparks, and even small pieces of ignited coal will be forced through any openings that may exist, and as it is impracticable to construct a boiler without a number of insecure openings, such as those of the furnaces, ash pits, and flue doors, smoke pipe joints, &c., fire is constantly being forced out through them, and a great number of steamers have been destroyed from this cause, added to which, the momentary firing of them from this cause is a matter of so very frequent occurrence, that if the public at large were fully aware of the risk of life they incurred in traveling in steamers where blowers are used, the abandonment of all such vessels would be so universal, that the owners of them would be compelled to remove this risk forthwith; their interest in this inducing their attention thereto more effectually than any law that might be enacted to reach them. So opposed to all propriety is the use of blowers, and so essentially necessary to the requirements of personal safety is the abandonment of them, that I question if a jury, composed of intelligent persons, with the facts fully before them, could be found throughout the entire country, that would not decide that a vessel in which they were used was unsuited to carry passengers, even on a river or sound, and unseaworthy on a lake or the ocean.

3. *Covering and protection to boilers.*—All boilers should be covered with a hair felting, both for the purpose of indicating when they are unduly heated, and as a means of preventing the radiation of heat from the boiler to the wood work around it. So well established are the advantages of felting boilers, both for the economy of fuel, security against fire, and comfort to a crew, with all engineers—and I wish to be understood as not using this term to include mere drivers of engines—that in some of the Atlantic, and in all Naval steamers, the felting of twice and thrice the ordinary thickness is used, added to which are fitted over it coverings of canvass and sheet lead.

Neglect of Protection to Wood Work around Boilers, their Chimneys and Smoke Pipes.

1. *Protection to wood work around boilers.*—The wood work immediately around a boiler, its steam chimney or drum, should be set off

from it as far as it may be practicable, consistent with the capacity of the vessel; thus, when a boiler is in the hold of a single decked vessel, it is not practicable to afford much space between its top and the under side of the deck beams above it without making a break in the deck, a measure not always consistent with the requirements of the vessel; neither is it desirable when the boilers are upon the guards of a steamer to construct a covering to them of a sufficint height to secure it from being fired by radiation of heat from the boiler. Neither is it imperatively necessary that there should be any great distance between a boiler and its surrounding wood work; one foot is a desirable distance, and even more would be preferable, but when blowers are not used, and a boiler is properly covered, the wood work around it if properly protected may be set within six inches of it with safety, and all wood work about a boiler, as well as the top and sides of the fire rooms, should be covered with sheet iron or zinc, secured in the manner already detailed, with the further precaution of placing the laps of the sheets upwards. When a metal covering is not used, several coats of thick whitewash, stiffened with a little glue, will answer a good purpose; in fact, I think this preferable to coverings of tin or zinc as they are usually put on.

2. *Protection to wood work around steam chimneys and smoke pipes.*—Chimney rooms should be afforded a space sufficient to admit of the passage of a man around the chimney, and should be without any floor, so as to furnish a free communication for the escape upwards of the heated air from around a boiler, and also to admit of the introduction of a hose pipe in the event of the wood work around it being ignited. Whenever a smoke pipe passes through a deck, however light its character, there should be an open space around it to admit of a current of air to pass through it, and between this space and the wood work there should be a metallic boxing containing water to guard the wood from ignition.

Want of Provisions against Fire.

Pumps.—Where security from fire is imperfect a greater regard to the provisions against it should be had; this requirement, however, is not observed, and the disregard to the safety of human life, and the interests of the underwriters, which so generally exists, is observable in the want of provisions against fire, as in the other points referred to.

All steam vessels should be provided with an independent steam fire engine and pump combined, and all sea-going steamers of magnitude should be provided with two, and an independent boiler to work them; fitted to these pumps there should be a sufficiency of hose (in good order) to lead to any part of the decks or hold; added to which there should be the proper number of hand fire pumps upon the upper deck of the vessel, with hose sufficient in length to reach to any part of the vessel forward or aft, according as the pumps may be located forward or aft, and which hose should be so fitted as to be capable of being attached to the hose of the engine pumps. Further, the provisions of the U. S. Law of 1852, regarding the carrying of fire buckets and axes should be rigidly enforced, and a non-compliance therewith should be held to be a forfeiture on the part of the owners of a vessel that was burned to any claim for loss on the Underwriters.

As many owners of steam vessels will think this suggestion of even one independent steam pump and a boiler, a requirement altogether unnecessary, and imposing too great a burthen upon them; they will be surprised to learn that I can support my views by a reference to the fact that most of the sea steamers belonging to this port are fitted with pumps of this character, and that many have two of them, and an independent boiler to operate them; further, that rarely does a month pass without the occurrence of a steam vessel upon the coast or ocean being saved from burning or sinking, solely by the use of these pumps, and under circumstances, too, when the ordinary engine and ship's pumps prove totally inadequate to meet the requirements of the case.

If the provisions against fire on board of steam vessels—both as to the means of subduing it, and the proper organization of the officers and crew in the event of fire—were such as to give confidence to the public, there would not, upon its occurrence, exist that want of reliance in the ability to arrest it which is so fatal to the chance of subduing it. When the officers of a vessel are aware of their insufficient means to arrest a fire, and the crew are without that observance of obedience and restraint which is due to discipline and a reliance in their officers, there can be little combination of efforts, and when the inflammable character of a steam vessel is considered, it will be admitted that it is not from the labors of one or a few individuals that success is to be anticipated. It requires a high order of even compulsory discipline for a crew to continue at their posts, with the knowledge that passengers are not only cutting off their means of safety by the occupation of the boats, but terror-stricken and frenzied, they are probably destroying that very means by their confused and ill-directed labors.

So long as the captains of steam vessels do not exhibit to the public that the provisions for personal safety and discipline on board of their vessels is generally adequate to the demand upon them, so long will their labors and that of their officers be rendered impotent, for the crew and passengers, judging of the present by the occurrences of the past, will look for such safety as that which their selfishness will direct, and their own resources will effect for them.

Store Rooms.

Engineers' Store rooms—Should be located away from the fire room or boilers; all inflammable and combustible materials like to turpentine, paints, oil, and tallow, should be kept in metal tanks, securely fastened to the deck, and both they and wiping-stuff, spun-yarn, &c., should be stored in a room other than a tool room or work shop, the location of which should be such that it not only could be readily reached in the event of its being on fire; but it should be so located as to receive sufficient light into it to set aside the use of artificial light, except at night, and then it should be lighted by a fixed light without the room, but shedding its rays into it, alike to the manner in which the magazines on board of vessels of war are lighted.

Lights.—Instead of the universal neglect to give to engine and fire rooms a sufficient light whereby the operations thereof may be conducted without the use of hand lamps; there should be fixed lights

of a construction and character suited to give full light to all parts of these rooms; thus setting aside the risk of firing a vessel by the upsetting of a lamp, &c.

Improvidence of Captains and Engineers.

Although this is the last cause to which I shall ask your attention, yet it is by no means the least worthy of reference; on the contrary, I consider that if a large majority of these officers better discharged their duties to their employers and to themselves, there would be but little occasion for me to have addressed you this communication.

Captains.—Captains of steam vessels in the superintendence of their construction and equipment, should pay that attention to the requirements of security and provisions against fire, which, if they are at all qualified for the position, their experience and observation will show them to be necessary. The interests of the owners of steam vessels require full attention to these points, their contract with the public, in a moral view, demands it.

Engineers.—As the security against fire on board of a steam vessel are more immediately under the supervision of the engineer than that of any other person, and as he is, or ought to be, better acquainted with the risks therefrom, a strict requirement should be demanded from him, both by the owner and commander of a steam vessel, as to the resort on his part to every practicable security against fire, and every available provision for it if it should occur.

Upon an engineer entering upon duty on board of a steam vessel, it is his first care to advise himself fully as to the security and provisions against fire, and the means to free the vessel from water in the case of her leaking or being bilged, and if she is not properly secured and provided, he should forthwith report this condition of affairs to the captain, and if he or her owner assumes the responsibility of not noticing this report, the engineer has discharged his duty, and he must abide events; if, however, it should happen that human life should be sacrificed by inattention to his report, and the case should come fairly before the public, I am of the opinion that like reports of engineers would receive better attention for the future. If engineers had adopted this course they not only would have effected a just attention to their representations, but they would have saved many lives, both of the public at large and of their own profession.

Unfortunately, however, engineers as a class are the last persons not only to assume this position, but to acknowledge its propriety; for instead of guarding against the dangers which they are best advised of, they appear to consider the exhibition of an indifference to them a point of honor. In corroboration of this, I could present many relations, clearly exhibiting that it is not through the providence of engineers, that the public and the underwriters are to look for safety.

Not only has it required ten years of labor and importunity to introduce the independent steam fire and bilge pump into a bare majority of steam vessels, even with the support and repeated exhibitions of it having saved both vessels and crew, but from the almost united resistance of engineers, it is likely to require a longer period than this to introduce

the practice of felting boilers, and protecting the wood work around them.

In fact, the disregard of the owners of steam vessels, and the neglect of the trust confided to the captains as well as engineers, in not directing and requiring the proper precautions against fire is almost universal, notwithstanding vessels and lives without number have been lost in consequence of this neglect, altogether inexcusable and without a justification upon any one point, or under any combination of circumstances.

With them the non-occurrence of a fire where the security is imperfect, is assumed to be conclusive as to the sufficiency of the security from its occurrence at any subsequent period, and if it has so occurred that a boat indifferently secured and provided against fire has run for a period without ever being fired, it would be found very difficult to induce either her owner, captain, or engineer, to adopt any change, having in view any improvement in her security against fire.

As the proportional loss of steam vessels by fire is greater with us than with any other nation, it is not amiss, as a measure of apology for us, that the cause of it should be referred to here, with the view of showing how this blot upon our fame has arisen.

Upon the first introduction of steam navigation in this country it was confined to rivers, bays, and the shores of Long Island Sound, and if a fire occurred, reliance for security of life was had more upon the facility with which the vessel could be run ashore, and the passengers and crew escape thereto, than the probability of subduing it by provisions for the purpose.

Had our first essays occurred at sea, and been restricted thereto like to those of the English, we would have commenced with a better observance of the requirements of security from fire, but unfortunately the burning of a steamer upon a river does not present itself to the feelings of the public, like to a similar occurrence at sea, where, from the losses and horrors that usually attend it, it is universally conceded to be the terror of the ocean.

My purpose in submitting these views to you, as has already been stated, is that of inviting your attention to this subject. If you should see fit to submit this letter to the public, it may be the means of arresting the attention of the owners and officers of steam vessels to the responsibilities of their positions, and should it cause them to reflect upon the nature of their duties both to the public and themselves, I cannot doubt but that some good may be effected thereby; if so, the interests of all and my object will be well accomplished.

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*American Railway Securities.**

It has often been asked why American railway securities and shares, usually excellent, rank so low in market price. The answer is because they have no English agency. Money is much dearer in America than in England. Left to American investors alone, American railways will

* From Herapath's Journal, Jan. 1857.

always, until the flourishing period shall arrive when American money matters will be on a par with English, stand at a lower figure in the market. French and Belgian railway stocks rank nearly equal with English from having London agencies, the absence of which depresses American.

Two great and highly successful American railway corporations, the Michigan Central and New York Central (the latter being the London and North Western railway of America), have recently supplied the deficiency, and established agencies in London for the regular transfer of shares and payment of dividends.

In the transfer department a plan has been adopted for the purpose of security, which, in these Robson and Redpath days, deserves attention.

"Messrs. George Peabody & Co., of 22 Old Broad-street, have been appointed the transfer agents of the Company, and the Union Bank of London the registrar of transfers, to countersign the stock certificates, an arrangement intended to guard the stock issues of the Company in a manner believed to be the most satisfactory of any yet practised."

Such is the new plan adopted by one of these large American Companies, which is also a counterpart of that by the other.

It certainly seems calculated to prevent fraud of the character which has so disgracefully blackened the face of 1856 in railway proceedings. With such checks against fraud and forgery, the Robson and Sadleir race must be deprived of their occupation.

For the Journal of the Franklin Institute.

Experiments made at the Steam Flour Mills of Messrs. Hecker & Brother, N. Y. By Chief Engineer, B. F. Isherwood, U. S. Navy.

By the kindness and liberality of Messrs. Hecker & Brother, I have been enabled to make a number of experiments at their Steam Flour Mills, situated at the foot of Bridge Street, in the City of Brooklyn, New York. In the prosecution of these experiments every facility was afforded me, and I received in addition the valuable assistance of late Chief Engineer William Sewell, U. S. Navy. The experiments extended from February 21st, to March 4th, 1855.

The mill contains four run of four feet diameter stones, together with the requisite smut machines, elevators for hoisting and lowering grain, &c., to supply the stones. The stones are used for grinding wheat, and for their normal speed are worked at about 228 revolutions per minute, making six revolutions to each double stroke of the engines pistons. The machinery operating the stones, &c., consists of two high pressure steam engines, fitted with a surface tubular condenser for condensing the exhaust steam and returning it to the boilers in the state of hot distilled water. No air pump is used, but both the steam and cold water sides of the tubes are open to the atmosphere, and consequently no vacuum is formed; the sole purpose of the condenser being to supply the boilers with fresh water, as owing to the locality sea water only could otherwise

be obtained ; the loss from leakage and non-condensation is replenished with rain water. A separate Worthington steam pump is used to supply the condenser with cold condensing sea water, which is pumped up from the bay. The boilers are of the ordinary high pressure kind, cylindrical with return cylindrical flues, and having as an appendage a cross boiler or heater. The dimensions of the entire machinery will be hereinafter given in detail.

The objects of the experiments were principally as follows, viz :—

1. To determine the friction resistance of the engines and main shafting, and to ascertain the law regulating that resistance in function of the speed of the pistons : that is to say, to determine the pressure required to work the engines and shafting alone at any given speed, and to ascertain if any increase of pressure on the pistons is required to work the engines and shafting, *per se*, at different speeds, and if any, what increase.

2. To determine the ratio of the increase of power required to grind wheat at increased speeds, and *vice versa :* that is to say, for example, what increase of power is necessary in order to grind at twice the speed.

3. To determine the potential and economical evaporation by the boilers : that is to say, to determine how much steam the boilers will supply in a given time, and how many units of weight of water are converted into steam per unit of weight of fuel.

4. To determine the efficiency of the condenser : that is to say, to determine what proportion of the steam supplied to it is condensed, and incidentally, the amount of condensing water required, its temperature, and the temperature of the water formed by the condensation of the steam.

5. To determine the general condition and efficiency of the engines with regard to the proportions of their steam passages, their cut-offs, &c., &c., and the most economical manner of using the steam.

The following are the descriptions and dimensions in detail of the different machinery, viz :

Engines.—Two horizontal direct acting engines, working upon the same shaft and at right angles to each other, their motion rendered uniform by a fly-wheel and governor. At each end of the cylinder there is a short D steam slide valve, the two are joined by a rod and worked by an eccentric. The cut-off valve first used was a balanced four-way cock, connected with, and variable by, the governor ; it was also variable momentarily by hand ; it was situated in the steam pipe at some distance from the steam slide valve, and worked with no other friction than what was due to its weight and snug fit. With this cut-off no throttle valve was used. The last cut-off is simply a sliding plate worked by the steam slide valve which draws the plate after it, thereby cutting off the admission of the steam into the cylinder at the very cylinder nozzles. This cut-off is fixed, and closes the steam port when the piston is 0·183 of its stroke from the commencement; a throttle valve controlled by the governor is used with it. The steam pipes leading from the boilers to the cylinders are well covered with felt and canvass, but the cylinders, their valve chests, and connecting pipe, are uncovered.

The following are the principal dimensions, viz:

Diameter of the cylinders,			15½ inches.
Stroke of pistons,		4 feet.	
Space displacement of *both* pistons per stroke,	9·982	cubic ft.	
Steam space between the first or variable cut-off, and the steam slide valve for both cylinders,	1·953	"	
Steam space between the steam slide valve and the piston, at *one* end of *both* cylinders,	0·049	"	
Area of the steam port, 1 1-16-inch broad by 6½ ins. long,			6·906 sq. in.
" exhaust port, 1⅞-inch " "			10·562 "
" steam pipe,			8·950 "

Gearing and Shafting.—The engines are connected at right angles to each other on a horizontal shaft 10 inches in diameter. This shaft carries the fly-wheel, and a toothed spur-wheel, 4 feet in diameter, to the pitch line, and 10 inches face—the teeth are 60 in number, and 1½-inch deep. This wheel gears into another of the same dimensions, working another horizontal shaft of 10 inches diameter, at the end of which a bevel wheel of 5 feet pitch line diameter, gears into another bevel wheel of the same dimensions, which operates a vertical shaft from which the power is taken for the work. The aggregate length of the horizontal shafting is 15 feet. The vertical shaft is 60 feet in length and 10 inches diameter at bottom, tapering to 3 inches diameter at top; it is steadied by six journals. The above gearing and shafting comprise what was revolved when the engines operated without load.

Condenser.—The condenser consists of a rectangular box open at the top, and containing a quantity of $\frac{1}{16}$th inch thick copper pipe, disposed horizontally in the shape of "*gridirons;*" that is to say, a number of parallel pipes of equal length lying in the same plane, and connected at each end by a cross-pipe. Each gridiron is composed of 20 tubes of 1¾-inch outside diameter, and 58 inches length, disposed parallel to each other in the same horizontal plane, and having a space of 1¾-inch wide between them; these tubes are connected at each end by a cross pipe of 7⅞-inches outside diameter, and 72 inches length; two cross pipes to each gridiron. These gridirons are five in number, they are disposed in the same vertical planes, and are connected at alternate ends by a short vertical pipe in the centre of the horizontal cross pipes.

The exhaust steam from the engines is admitted through a pipe of 7⅞-inches outside diameter, into the centre of one of the cross pipes of the top gridiron, whence it traverses the succeeding descending gridirons from right to left, and from left to right, alternately, until it arrives at the extreme cross pipe of the lowest gridiron in the state of hot water, which then flows through a small pipe into an outside reservoir open to the atmosphere, whence by a pump connected with the engines, it is continuously drawn off and fed back to the boiler.

The cold sea water for condensing is pumped up from the Bay by a No. 3 Worthington steam pump, and is delivered through a pipe at the bottom of the condenser, whence it rises and runs back to the Bay through an overflow of 8 inches diameter at the top of the condenser; the overflow orifice being above the level of the water in the Bay. The

loss by leakage and non-condensation is replenished with rain water. There is no air-pump, and owing to the fact that both the cold condensing water and the hot water of condensation are open to the atmosphere, the pressure on both sides the tubes will be equal, although *all* the exhausted steam were condensed. For the same reasons, the pressure within the tubes, even with a perfect condensation of the exhaust steam, could never be less than that of the atmosphere.

The diameter of the Worthington steam pump is 7 inches, stroke of piston 7 inches. Diameter of the steam cylinder working the pump 12 inches, stroke of piston 7 inches. The following are the dimensions of the condenser, viz:

Length inside of case,	7 feet.
Breadth "	7 "
Height "	4 " 8 inches.
Cubic contents of inside of case,	228·67 cubic ft.
Number of copper pipes 1¾-inch outside diameter, and 58 inches length,	100.
Number of copper pipes 7⅞-inch outside diameter, and 72 inches length,	10.
Number of copper pipes 7⅞-inch outside diameter, and 2 inches length,	4.
Area of condensing surface in all the above pipes,	303·7 sq. ft.

Boilers.—There are three cylindrical boilers, 44 inches outside diameter, and 30 feet length, placed side by side, set and embedded in brick work in the usual manner. Each boiler contains two return cylindrical flues of 12 inches internal diameter, and 30 feet length. On the top of each boiler is a cylindrical steam drum of 30 inches internal diameter, and 63 inches height; the steam drums are connected at the top by a cross pipe which continues to the engines, and supplies them with steam. The drums and steam pipe are well covered with felt and canvass. The boilers are completely surrounded and covered with brick masonry, so as effectually to prevent the radiation of heat. There is but one furnace, and it is situated below and at one end of the boilers, the fire grates extending clear across without interruption. The grate bars are ¾-inch wide on top, with air spaces of ¼-inch wide between them; in cross-section, the bars bevel towards the bottom, where they are only ⅛-inch wide, with air space ⅞-inch wide between them. Beneath the three boilers, and lying in a direction at right angles to them, is a cylindrical cross boiler or heater of 36 inches external diameter, and 12 feet 2 inches length; this cross boiler having its top connected with the bottom of each of three boilers by a short pipe, is placed in the current of heated gases flowing from the furnace to the chimney, so as to cause the gases to impinge against and be deflected around it. The feed water is pumped into the cross boiler—which is always full of water—and finds its way into the three upper boilers through the connecting pipes. There are four brick bridge walls, similar to each other, in the length of the boilers; they are curved on the top concentrically with the bottoms of each boiler, having a space of 4½ inches left for the passage of the heated gases between the tops of the walls and the bottoms of the boilers.

The following are the principal data of the boilers, viz:

Area of the shells of the three boilers exposed to the heated gases,		510·11 sq. ft.
" cylindrical return flues of the three boilers,		565·49 "
" shell of the cross boiler exposed to the heated gases,		93·06 "
Total area of heating surface,		1168·66 sq. ft.
" " grate "		57·50 "
Cross area between top of bridges, walls, and bottoms of boilers,		6·415 "
" of the cylindrical flues of the three boilers,		4·712 "
Distance traversed by the heated gases from the centre of the furnace to their exit from the flues,		68 feet.
Height of the smoke chimney above the boiler grates,		90 "
Steam space in the shells of the three boilers,		365 cubic "
" " drums " "		77 " "
Total steam space,		442 cubic feet.
Ratio of grate to heating surface,	1·000 to 20·325.	
" cross area between bridges, walls, and boilers to grate surface,	1·000 to 8·963.	
" cross area of the cylindrical return flues,	1·000 to 12·203.	
Aggregate area of air spaces between the grate bars,		13·52 sq. ft.

Determination of the Friction Resistance of the Engines and of the Main Shafting, per se, and of the Law regulating that resistance in function of the speed of the engines' pistons.—Before commencing the experiments hereinafter described, the power required to overcome the friction of the engines and of the main shafting, *per se*, was determined by a great number of trials at different speeds of the engines' pistons. For this purpose indicator diagrams were taken from each engine; each diagram was traced thrice by the pencil, and where there was any deviation that diagram was rejected. The results thus obtained were found to very closely correspond, the *pressure* being sensibly the same at *all* velocities of piston, showing that the *power* required to overcome the friction resistance of the engines and shafting, was in the direct ratio of the speed of the piston; for the *power* is the product of the *pressure* and the *speed*. During these trials the speed of piston was varied by the throttle-valve from 17 to 44 double strokes per minute, or from 136 to 352 feet per minute. Although the *pressure* on the piston continued always the same to overcome the friction resistance, be the speed of piston what it might, yet for increased speeds it was necessary to open the throttle-valve wider in order to supply the greater quantity of steam required in the same time; so that in order to obtain greater and greater speeds of piston, the throttle-valve needed to be more and more opened, but the pressure remained sensibly the same in all cases, only the opening for the admission of the steam was increased with the increased speed of piston, in order to supply the increased quantity of steam required for maintaining the *same* pressure at the increased velocity of piston. These experiments were varied by entirely shutting off the steam from one engine, and overcoming the friction resistances of both engines and the shafting with the other; in this case, the pressure just doubled what it was with both engines functioning.

The above results are confirmative of the well established law of friction, viz: that it is independent of speed, and that the quantity is measured solely by the space through which it moves; the same friction

moving through a double space requiring a double power, be the velocity of its motion what it may. The resistance of the atmosphere to the moving parts of a steam engine, doubtless makes the power required to work it, *per se*, to increase in a ratio slightly greater than direct; but the atmospheric resistance is so slight, and the opposed surface of the moving parts of the engine so small, that the effect is practically inappreciable. The following table contains a selection of the results from a considerable number of diagrams; they will enable the reader to perceive the limits of variation, the widest of which are therein included. Indicator diagram No. 1, is a representative diagram taken with both engines, functioning and overcoming only their friction and the friction of the main shafting. No. 2 is a representative diagram, taken with one engine only functioning, the steam from the other being entirely shut off, overcoming the same friction resistance as in No. 1.

Table containing the results of trials made to determine the Friction Resistance of the two Engines and Main Shafting.

Number of double strokes of engines' pistons made per minute.	Mean effective pressure throughout stroke, in lbs. per sq. in. of pistons.	Mean back pressure above the atmosphere throughout the stroke, in pounds per square inch of pistons.
17	3·94	1·00
17	3·70	1·00
18	3·75	1·00
19	3·75	1·00
19	3·70	1·00
22	3·80	1·12
22	3·94	1·13
38	3·90	1·50
38	3·75	1·50
38	3·95	1·50
38	3·90	1·50
44	3·75	1·75
44	3·70	1·75
44	3·95	1·75
Means,	3·82	1·32

From the above table it will be perceived, that the variations due to imperfections of instrument and observation, were comprised within very narrow limits, the minimum being 3·70, and the maximum 3·94, a difference of 3·14 per centum from the mean 3·82. It will also be observed, that the "back pressure" increased with the increased speeds of piston, which is what should have been the case, there being more steam to be exhausted through the same opening in equal times in the direct ratio of the speed of piston.

Determination of the power required to grind Wheat in Function of Speed.—Experiments were made to determine the relative economy of *power* in grinding wheat at a lesser or greater speed; that is to say, to determine the ratio of the power employed when the mill stones were rotated at different speeds, the same feed being kept on. For this purpose the machinery was worked at full speeds, at two-thirds speed, and at

half speed, and indicator diagrams were taken at 30 minutes interval; the diagrams were in all cases traced thrice by the pencil, and those showing any disagreement were rejected. The following table contains the data and results, viz:

Table containing the Results of Trials made to determine the Relative Economy of Power in Grinding Wheat at Different Speeds.

Series.	Pressure in pounds per square inch above the atmosphere.					Steam cut-off at in cylinder from commencement of stroke of pistons.	Actual coefficient of expansion of the steam.	Number of double strokes of engines' pistons made per minute.	Available horses power developed by the engines after deducting 3·82 pounds per sq. inch of pistons for friction of engines and shafting.	Cubic feet of steam of atmospheric pressure used per minute calculated from the pressure at the end of the stroke.	Ratio of pres. on opp's'g sides of piston.		Ratio of total back pressure to total average pressure.	Number of lbs. of wheat cleaned and ground into flour per hour.
	Mean effective pressure on pistons throughout the stroke.	Mean back pressure on the pistons throughout the stroke	Steam pressure in boilers.	Initial steam pressure in cylinders before cutting off.	Steam pressure in cylinders at the end of the stroke above the atmosphere.						Total av'g pres. throughout the stroke includ'g atmosphere in lbs. p.sq.in. pist'n.	Total av. back pres. throughout the stroke incg atmosphere in lbs. p.sq.in. pist'n.		
A	22·00	2·63	95	38·25	11·25	0·26								
	18·00	2·80		36·00	9·75	0·23								
	17·63	2·30		38·63	7·50	0·20								
	16·88	2·20	From 95	38·63	6·00	0·16		36						
	17·48	2·70	to 100	36·00	7·00	0·22								
	20·63	2·77		34·50	10·50	0·28								
	18·98	2·70	98	33·40	9·75	0·26								
	19·43	2·80	98	33·75	9·76	0·30								
Means	18·88	2·61	97	36·14	8·93	0·239	0·712	36	47·23	1116·2	36·19	17·31	0·478	27
B	11·78	1·75		27·00	3·00	0·25								
	11·04	1·50		24·25	3·00	0·25		18						
	11·10	1·50	Steam throttled off.	24·00	4·20	0·25								
	11·37	2·00		23·40	4·50	0·25								
	11·25	1·50		23·63	3·00	0·25								
Means	11·31	1·65		24·46	3·60	0·25	0·707	18	14·75	441·3	27·66	16·35	0·591	13½
C	51·00	4·58		75·00	30·00	0·37								
	48·83	4·84		75·00	27·00	0·33								
	51·97	5·31		75·00	33·00	0·36								
	50·03	5·14		75·00	30·00	0·34		39						
	49·16	5·25	83	72·75	29·30	0·35								
	50·25	4·75		75·75	30·00	0·34								
	51·94	5·13		75·00	31·50	0·34								
	52·27	5·03		75·00	32·25	0·35								
Means	50·68	5·00	83	74·81	30·68	0·348	0·786	39	159·21	2196·9	70·38	19·70	0·280	78
D	33·07	2·16	96	73·50	16·50	0·13								
	37·42	2·63	97	75·75	19·50	0·15								
	36·90	2·51	96	75·00	18·00	0·15								
	34·86	2·45	96	75·00	18·00	0·15		26½						
	35·85	2·37	94	75·75	17·60	0·16								
	36·75	2·82	89	74·00	18·75	0·18								
	34·88	2·95	84	68·00	16·50	0·18								
	34·73	3·10	84	69·00	17·25	0·18								
Means	35·56	2·62	92	73·25	17·76	0·16	0·601	26½	73·27	1098·9	52·88	17·32	0·328	53

In the above table, comparing series A and B, which were taken with the same mill stones and feed on, the speed being in series B one-half

of what it was in series A, and the quantity of wheat cleaned and ground one-half; we perceive that after deducting 3·82 pounds per square inch of pistons for the friction resistance of engines and shafting, the average pressures on the pistons per square inch were (18·88—3·82=) 15·06, and (11·31—3·82=) 7·49 pounds, or sensibly in the ratio of 2 to 1; that is to say, to make twice the number of double strokes of pistons in equal times, twice the pressure was required on the pistons. But the speed at which these pressures moved compared as 2 to 1, and with the double speed, twice the quantity of wheat was cleaned and ground; consequently, the powers 47·23 and 11·75 horses, which are the products of the pressures and speeds, compare as 4 to 1; that is to say, to grind in equal times twice the quantity of wheat by grinding it at double velocity, requires four times the power.

Again, in comparing series C and D, during which exactly the same condition of things existed, with the exception of the speed, which compared as ($\frac{39}{36\cdot5}$=) 1·4717 to 1·0000; we perceive that after deducting 3·82 pounds per square inch of pistons for the friction resistance of engines and shafting, the average pressures on the pistons per square inch were (50·68—3·82=) 46·86, and (35·56—3·82=) 31·74 pounds, or in the ratio of 1·4764 to 1·0000, or sensibly in the same ratio as the number of double strokes of pistons in equal times. The quantity of wheat cleaned and ground with series C, was 78 bushels per hour; with series D, 53 bushels per hour, or in the ratio of 1·4717 to 1·0000, being exactly in same ratio as the number of double strokes of pistons made per minute. The power with series C was 159·21 horses, with series D, 73·27 horses, or in the ratio of 2·173 to 1·000. But the quantities of wheat cleaned and ground compared as 1·4717 to 1·0000, and the squares of 1·4717 and 1·0000 are 2·166 and 1·000, or sensibly in the ratio of the powers 2·173 and 1·000. Hence, we perceive, that the amount of wheat ground, is in the direct ratio of the number of double strokes of pistons, but that the power required to grind is in the ratio of the squares of the number of double strokes of pistons in equal times, and that the pressure required to develop this power, is in the direct ratio of the number of double strokes of pistons in equal times.

The indicator diagrams in series A, B, C, and D, were taken at half-hour intervals. The quantity of wheat cleaned and ground was accurately measured. From 36 to 39 double strokes of engines' pistons was the usual speed of grinding.

With series A, and a speed of 36 double strokes of pistons per minute, there was required for cleaning and grinding 27 bushels of wheat per hour, 47·23 horses power, or ($\frac{47\cdot23}{27}$=) 1·749 horse power per bushel. With series C, and a speed of 39 double strokes of pistons per minute, there was required for cleaning and grinding 78 bushels of wheat per hour, 159·21 horses power, or ($\frac{159\cdot21}{78}$=) 2·041 horses power per bushel. The squares of the speeds 36 and 39, compare as 1·000 and 1·173; the powers 1·749 and 2·041 compare as 1·000 and 1·167, or sensibly the same. It is obvious from the foregoing, that a judicious economy requires a low speed of grinding, and that it is far more economical to employ a greater number of stones to do the required amount of grind-

ing at low speed, than a lesser number at high speed. When grinding at from 36 to 39 double strokes of engines' pistons per minute, corresponding to 216 and 234 revolutions per minute of the four feet diameter mill stones, the flour comes from the stones so hot as to require cooling before it can be packed into barrels. This is opposed to the usual practice of English millers, who obtain the flour from the stones so cold that it can at once be run into the barrels; of course, they grind at a much lower speed. Mr. Ellwood Morris (vide *Journal of the Franklin Institute*, vol. iv. 3d Series, p. 22), ascertained by direct experiment on three excellent overshot flouring mill wheels, having all the modern improvements, that calculating from their whole head and fall while they turned at their usual velocity, everything being in perfect order, they required 788 cubic feet of water, falling one foot per minute, to grind and dress one bushel of wheat per hour. This is an expenditure of power equal to ($788 \times 62\frac{1}{2} =$) 49250 pounds, moving at the rate of one foot per minute, or to ($\frac{49250}{33000} =$) 1·493 horse power per bushel of wheat per hour.

Determination of the general condition and efficiency of the Engines with regard to the proportions of their Steam Passages, their Cuts-off, &c., and of the most economical manner of using the Steam.—The experiments made for the purposes of determining the ratio of the power required to grind wheat at different speeds—the evaporation by the boilers; the consumption of steam with the two cuts-off, &c., &c., furnish the means of determining the various points of back pressure, average pressure throughout the stroke, ratio of boiler to cylinder pressure before cutting off, actual co-efficient of expansion of the steam, economy of fuel, &c., corresponding to different steam pressures, points of cutting off, and speeds of pistons. The data and results of these experiments will be found grouped into series in the following table. The means of series A, B, C, and D, are from the immediately preceding table. Series E, F, and G, are the mean of fifteen indicator diagrams taken at ten minutes intervals; series H, is the mean of 31 diagrams taken at 20 minutes intervals; series I and J, are each the mean of twenty-eight indicator diagrams taken at 15 minutes intervals.

All the series of the table, with the exception of series J, were taken with the first or variable cut-off, cutting off in the steam pipe. Series J was taken with the last or fixed cut-off, cutting off at the cylinder nozzles.

With series A, B, and F, the steam was found to be greatly throttled in the steam pipe at the old throttle-valve, which was unused, but allowed to remain. This throttle was a cock, and when examined was found to give, when wide open, an area for the passage of the steam of but 5 square inches; after passing this contraction, the steam had still to pass the cut-off, and the steam slide valve, before it could enter the cylinder.

			A	B	C	D	E	F	G	H	I	J
Relative economy of fuel.	Total horses power.	Cubic feet of steam of atmospheric pressure per total horse power proportionably.	1·923	2·536	1·301	1·365	1·267	1·639	1·301	1·396	1·368	1·000
		Cubic feet of steam of atmospheric pressure per total horse power.	18·60	24·88	12·76	13·39	12·43	16·08	12·76	13·72	13·43	9·81
	Available horses power.	Cubic feet of steam of atmospheric pressure per available horse power proportionably.	2·114	3·359	1·234	1·342	1·207	1·664	1·279	1·389	1·358	1·000
		Cubic feet of steam of atmospheric pressure per available horse power.	23·63	37·56	13·80	15·00	13·49	18·60	14·30	15·53	15·18	11·18
Ratio of the pressures on opposing sides of pistons.		Ratio of total back pres. to total av'ge press.	0·478	0·591	0·280	0·328	0·301	0·343	0·340	0·358	0·365	0·350
		Total average back pressure throughout the stroke, including atmosphere, in pounds per square inch of pistons.	17·31	16·35	19·70	17·32	19·46	17·48	18·24	18·27	17·92	16·78
		Total average press. throughout the stroke including atmosphere, in pounds per sq. inch of pistons.	36·19	27·66	70·38	52·68	64·58	45·45	53·64	51·07	49·14	48·00
Cubic feet of steam of atmospheric pressure used per minute, calculated from the pressure at the end of the stroke.			1116·2	441·3	2160·9	1068·9	1808·6	1381·1	1494·6	1450·6	1390·0	1030·4
Total horses power developed by the engines *including* the 3·82 pounds per square inch of pistons for friction of engines and shafting.			59·20	17·74	172·18	79·27	142·71	85·89	117·19	106·72	104·98	104·98
Available horses power developed by the engines after *deducting* the 3·82 pounds per square inch of pistons for friction of engines and shafting.			47·38	11·75	150·21	73·27	134·07	74·24	104·54	93·41	92·14	92·14
Number of double strokes of engines' pistons made per minute.			36·0	18·0	39·0	36·5	35·0	35·0	28·0	37·0	28·6	28·6
Actual coefficient of the expansion of the steam.			0·712	0·707	0·786	0·691	0·729	0·827	0·634	0·634	0·566	0·528
Steam cut-off at in cylinder from commencement of stroke of pistons.			0·259	0·250	0·348	0·119	0·208	0·412	0·297	0·263	0·152	0·183
Pressure in pounds per sq. in. above the atmosphere.		Steam pressure in cylinders at the end of the stroke above the atmosphere.	8·93	3·00	20·48	17·76	23·43	16·92	15·91	15·80	13·30	5·36
		Initial steam pres. in cylin's before cut'g-off.	30·14	24·46	74·81	73·25	74·23	40·50	67·40	60·00	72·00	76·20
		Steam pressure in boilers.	57	82	83	92	83	87	80	81	91	80
		Mean back pressure on the pistons throughout the stroke.	2·61	1·66	5·00	2·62	4·36	2·58	3·64	3·67	3·22	2·98
		Mean effective pressure on pistons throughout the stroke, including the 3·82 lbs. per sq. in. for friction of engines and shafting.	18·88	11·31	50·08	35·56	44·32	28·17	33·40	32·80	31·22	31·22

In series A, the cock-throttle being wide open, the steam pressure in the cylinder before cutting off was only 37·26 per centum of the boiler pressure, comparing the pressures above the atmosphere, the cut-off closing at 0·239 of the stroke of pistons from the commencement. The cut-off was then changed to close at 0·412 of the stroke from the commencement, when the cylinder pressure became 46·50 per centum of the boiler pressure, and could not be made higher even when cutting off longer. As soon as this effect of the throttle was discovered, it was removed entirely, leaving the area of the steam pipe at that point 8·95 square inches. Series E was then taken, the cut-off closing at 0·298 of the stroke from the commencement; the cylinder pressure now rose to 87 per centum of the boiler pressure.

It is necessary to here explain that the first cut-off valve could be adjusted at will, making it close sooner or later by giving its axis less or more vibration; but just in proportion as the vibration was lessened, was the opening for the passage of the steam decreased, so that the cut-off valve had the double functions of an expansion valve and a throttle valve—the shorter it cut off the more it also throttled. It was a necessity of its construction also, that the tapering cylindrical plug should be an easy fit in its chamber, and it was adjusted by screws that had to be regulated continually for the unequal expansions of the plug and its chamber; there resulted from this, that the valve leaked unequally in a small degree, sometimes leaking more steam than at others, which is perceptible on comparing the actual co-efficients of the expansion of the steam as given in the above table, with the points of cutting off. The comparative ratio of throttling by the cut-off valve when adjusted at different points of cutting off, appears in the following table, viz:—

Series.	Point of cutting off from the commencement of the stroke.	Ratio of the cylinder to the boiler pressure.	Series.	Point of cutting off from the commencement of the stroke.	Ratio of the cylinder to the boiler pressure.
I	0·152	0·79	G	0·237	0·84
D	0·160	0·80	E	0·298	0·87
H	0·203	0·82	C	0·348	0·90

Finally, it was determined to remove the variable cut-off valve, and replace it with a fixed cut-off valve, cutting off the steam at the cylinder nozzles. For this purpose a movable frame was placed in the valve chest around the steam slide valve, but with a certain amount of play between the ends of the steam valve and the frame. By this arrangement the steam valve was free to move alone a short distance, when it struck the frame and drew it after it, the frame closing over the steam port and cutting off the steam. The same eccentric worked both steam and cut-off valve; in fact, the arrangement amounted to working the cut-off by a tappet on the stem of the steam valve with the advantage that the steam was cut off exactly at the cylinder nozzles. The width of the frame pieces at the ends of the frame amounted to so much lap placed on the steam valve, which acted to cut off the steam very short without the disadvantage of disarranging the exhaust. The addition of this frame did not require the eccentric of the steam valve to be changed. The side pieces of the frame were, of course, only useful to connect the end pieces of the frame. With this cut-off, the first one having been entirely removed, series J was taken, when the cylinder pressure rose to 95 per centum of the boiler pressure, showing that a proportion of 1 square inch of opening to every 1249 cubic inches of space displacement of piston per stroke, was sufficient for the admission of steam, having 95 per centum of the boiler pressure with a velocity of piston of 308·8 feet per minute. The steam pipe was 30 feet long, with three right-angled bends.

The reason for changing the cut-off valve, was to avoid the loss of the expansion of the steam between the first cut-off valve and the steam

slide valve. This loss, from the great capacity of that space which was equal to the area of the cylinder by a length of 0·783 foot, was very considerable. The result of the change was extremely satisfactory, as will appear from a comparison of series I and J, taken to practically determine the point. In both series, the mean effective pressure throughout the stroke of piston, number of strokes of piston made per minute, and horses power developed by the engines, were made precisely the same; the ratio of the back pressure to the average pressure for the stroke was also nearly the same, but with series I (first cut-off), the steam was cut off at 0·152 of the stroke of piston from the commencement, while with series J (last cut-off), the point of cutting off was fixed at 0·183 of the stroke; but notwithstanding this disadvantage, the gain in steam, and consequently in fuel, amounted to 35·8 per centum—that is to say, if the fuel required with the last cut-off be taken at 1000 for a given power, then to obtain the same power with the first cut-off, would require of fuel 1358. After these experiments the last cut-off was permanently retained, giving steadily the above gain of fuel. With the last cut-off a gain was also effected in the back pressure, the final pressure in the cylinder at the end of the stroke being considerably reduced (in series I and J, from 13·50 to 5·36 pounds per square inch above atmosphere), and as a consequence, there was a less quantity of steam to exhaust through the openings, making the back pressure on the pistons above the atmosphere respectively 3·22 and 2·08 pounds per square inch, while the average pressure throughout the stroke remained the same.

(To be Continued.)

Extracts from the Engineer's Report to the Trustees of the Philadelphia Gas Works, for the year 1856.

The several factories belonging to the Trust, have produced in the year 1856, four hundred and thirty-four million seven hundred and forty-two thousand cubic feet of gas; of which 163,930,000 cubic feet were made at the works in First Ward; 184,357,000 in Ninth Ward, and 86,455,000 in Fifteenth Ward.

The largest quantity used in twenty-four hours, was 2,166,000 cubic feet, on the last night of the year, and the largest daily product of the several works has been 799,000 in First Ward; 1,084,000 in Ninth Ward, and 440,000 in Fifteenth Ward.

These maximum daily productions did not occur simultaneously, and therefore their aggregate amount was not produced on any one day, it having been found most convenient to manage the different factories in such way, that one might be in full working, when the yield of another had fallen off by reason of the wear of its retorts.

The largest daily average yield of each retort in the year was

7194	feet at the works in	First Ward.
5382	"	"	Ninth Ward.
5150	"	"	Fifteenth Ward.

The largest quantity from each pound of coal respectively, made for any full day's work.

$4\frac{92}{100}$ feet at the works in First Ward.
$4\frac{65}{100}$ " " Ninth Ward.
$4\frac{64}{100}$ " " Fifteenth Ward.

At the several manufacturing stations no new constructions have been undertaken in the past year; the improvements completed being only those that had been previously commenced.

Of these, the most important is the large gas-holder, No. 12, which was so far completed in the autumn as to be in good working condition. It was put in operation early in the winter, and has continued to work with great steadiness and regularity.

Its efficiency as a great reservoir and regulator of pressure, during the hours of maximum consumption, has fully equalled every expectation. Its advantages in these respects cannot easily be over-estimated, and by its steady action during several violent gales of wind, it proves that a gas-holder of very large dimensions is much more dependable than those that are smaller.* Notwithstanding the unexpected obstacles encountered in the construction of this gas-holder and tank, by reason of the difficult character of the foundations and casualties of the weather, it is worthy of note, that its cost per cubic foot, of capacity, is much less than that of any other gas-holder ever built at these works, with the exception only of No. 11, which being also of unusually large size, was constructed at less cost per cubic foot than any other, of which I have any knowledge, in the United States.

Had the unlooked-for difficulties alluded to, not occurred, the relative cost of No. 12 would have been below that of No. 11, and it may now be esteemed an established truth, that in all large works economy is promoted by the use of gas-holders of very large dimensions. As it is believed that two gas-holders of as large capacity as these, are not to be found at any other Gas Works, the present may be considered a suitable occasion for a brief description of them.

No. 11 was built in 1850, and has been in almost constant use since that year. It is of telescopic plan, 140 feet in diameter and 70 feet high, containing one million cubic feet.

Gas-holder No. 12 was put in operation early in December last; it is like the other, telescopic in form, 160 feet in diameter and 90 feet high, containing one million eight hundred thousand cubic feet. The tank is 162 feet in clear diameter, and 46 feet deep, excavated in gravel and clay, with a central mound 25 feet high.

When the excavation for this tank had been sunk nearly to the depth required for the foundation and floor, the substratum of stiff clay was forced upward by the pressure of water beneath, revealing a quicksand that existed about 55 feet below the top level of the tank, which had not been detected by borings previously made to a depth of more than

* Since the presentation of this report to the Trustees, the occurrence of the great snow storm, of January 18th, accompanied by a gale of unusual violence, has afforded another opportunity for testing the stability of this gas-holder. At the time of the storm it was raised more than forty feet high, containing over 800,000 cubic feet of gas, and showed not the slightest symptom of unsteadiness or excessive strain.

50 feet, for the purpose of proving the nature of the ground. This unwelcome discovery made it necessary, for the proper security of the foundations, to adopt some expedient for reaching a firm bed of gravel, which was found to lie about 70 feet from the surface. The great influx of water at this depth, of more than 40 feet below tide, forbade any other mode of reaching this solid bottom than by driving piles. Some thousands were driven in such positions as would allow the tank walls, the guide towers, and the floor, to rest on heavy timbers secured by bolting to the piles after the latter had been driven home in the solid gravel below.

These timbers are laid close together, radiating from the central mound to the outer circumference of the foundation walls; their joints were tightly caulked, and the whole covered with a bed of hydraulic concrete. The tank walls are of rubble masonry, built in two separate rings, the outer one, four feet thick, laid in gravel mortar; the inner one, eighteen inches thick, laid in hydraulic cement, with an interstice of six inches filled in with hydraulic concrete. To increase the tightness of the bottom, it is covered by a dome-shaped pavement of brick, grouted with hydraulic cement. An annular wall of stone is built within the tank, midway between the outer wall and the centre. Upon this are placed 24 tressel frames, 35 feet high, which sustain the crown of the gas-holder, so as to prevent the swag of the sheets when unsupported by the gas. No rafters are used, nor any interior frame work, except a series of tie-rods, which are secured to the crown sheets in such way as to distribute over its entire area the weight of the centre post and the vertical sides.

This arrangement was adopted in consequence of the great weight required to give the holder such pressure as would control all the others connected with the several works, all of which are more than three miles distant, and some two and three times more remote.

To facilitate the future increase of its pressure, the legs on which the inner section stands, and against which the outer section is guided, are made of cast iron, and hollow, for receiving the additional weights that may hereafter be required.

To support and guide the gas-holder, there are twelve towers of cast iron, ninety-five feet high, standing on stone bases; their form is pentagonal, about twelve feet in diameter. The girders connecting the towers are in the form of a heavy balustrade, with open quatrefoil panels, and are placed fifteen feet below the summits of the towers.

The weight of metal in the whole structure is over one thousand tons. That of the gas-holder alone about three hundred tons.

To those who are not familiar with the properties of gases, it may appear incredible that a vast structure, weighing over 600,000 pounds, can be sustained with safety, resting solely upon a fluid so light and subtle as illuminating gas, whose density is less than half that of atmospheric air, or only one sixteen-hundredth part the weight of water. But the great diameter of this machine gives it an area of 20,000 square feet, and the whole pressure due to its weight is only 30 pounds on the square foot, equal to a column of water not quite six inches high.

It is therefore raised with the greatest ease by the inflowing gas; by

which it can be lifted out of the water of the tank, to a height of ninety feet, and as the gas is consumed or passed into the other holders, it is gently lowered, with the silent, steady motion of a great pneumatic press.

Another structure which has been completed during the past year, is the hydraulic elevator, used for raising coals from the wharf, into the coal stores recently constructed at the First Ward works.

The construction and operation of this machine are of extreme simplicity. Two rectangular water-tight boxes, made of boiler iron, capable of holding about 1½ tons of water, each, are suspended to the ends of a strong chain that passes over a wheel placed at the top of the hoisting tower. The length of the chain is such, that one box is level with the railroad track on the wharf, when the other is level with a similar track leading into the attic of the coal stores; a short section of rail track on top of each box is adjusted to fit these main tracks when the boxes are in place.

A loaded car being run on to the lower box, and a light car on the upper one, water is allowed to flow into the latter, from a cistern, until its weight preponderates, when it descends and raises the loaded car, its velocity being regulated by means of a powerful friction brake, which is worked by an attendant, who likewise works the valves for supplying the water.

When the descending car reaches the bottom of the tower, a self-acting valve opens and allows its load of water to escape.

After the coals have been delivered from the vessel at the wharf, into an iron car, placed on a railway laid along the water's edge, they need no further handling, being drawn by a mule to the platform of the elevator, by which they are hoisted 60 feet, to a track leading into the attic of the coal stores, when they are dropped from the car, at a height which allows the pile to trim itself to the slope of the roof; thus filling up the store more completely than could be done by any other mode, and saving more than three-fourths the expense of storing in the usual way. As the two coal stores now erected are capable of holding only about one-half the coal required for the winter's supply, it will be a measure of good economy to build two more in the present year; whereby the saving of expense in handling and hauling may be gained upon the whole quantity used, and the coals may be more perfectly protected from damage, than they can be in temporary sheds.

In constructing the retort benches at the First Ward station, provision was made for their adaptation to various different plans of setting the retorts in the fire arches, without disturbing the permanent masonry. The superior facilities for making comparative trials of different plans thus secured, have not been without their proper fruits.

The Assistant Engineer, under whose immediate direction the works at this station are placed, has introduced a new plan of setting in an open arch, disencumbered of the usual complex arrangement of flues, from which he has produced results much more economical than any heretofore obtained at the older works. The daily yield when the beds are new and in good condition, has been over 8000 cubic feet of gas from each retort, or about 25,000 from a bed of three. The aver-

age yield, during the operations of an entire season, has been nearly 7000 feet a day from each retort, or 20,000 feet from the bed of three.

The contrast of results derivable from different modes of setting the retorts, is exhibited very clearly in a trial made at the request of a Trustee, of another plan of setting, used in a neighboring City. In order to ensure the utmost fairness and accuracy of the comparison, the retorts used were of the same pattern, exactly alike in all respects. The beds in which they were placed, were immediately contiguous in the same section of retort bench, and were worked by the same gang of stokers, using the same kinds of coal and fuel. The trial was continued many months, and until the retorts were used up, so far as practical economy of use would permit. The contrast is remarkable and instructive. When the new setting was first put at work, with the flue dampers adjusted according to instructions given by its suggestor, the daily yield was about 3700 feet to the retort, or 11,000 to the bed of three retorts. By a different adjustment, found upon experiment to produce the best results obtainable, the yield was increased to 4300 feet per day from each retort, or about 13,000 feet from each bed of three. This was the utmost they could be made to yield, without endangering the destruction of the bed by melting down the furnace.

As these results speak for themselves, they require but brief comment. The cost for retorts, for retort-house room, and for labor of working, is the same in both the plans of setting; the daily product in one case exceeds that in the other by one-half.

The setting in open arches, when fully introduced, will much increase the capacity and profitable results of our works; the other would take largely from us in both these respects. The practical difference between the adoption of the one or the other, in its money value, on our present scale of operations, would amount annually to the interest on a capital of more than half a million of dollars.

Another year's trial of the cellular retort, for the production of gas from vegetable substances, has confirmed the results heretofore reported, with respect to the quantity and illuminating quality of the gas thus obtained. As there seemed to be some doubt as to the permanency of this gas, it was thought worth while to test it in such way as would bring the question to a satisfactory solution.

A considerable quantity of it (30,000 cubic feet) was stored in a gas holder by itself, and after remaining thus isolated several weeks, was tested photometrically. It had not changed perceptibly, having retained its illuminating power as completely as coal gas under similar trial.

With the present relative prices of wood and coal in the Philadelphia market, the cost of making gas from the former is somewhat the lower, but the difference is not sufficient to justify the immediate abandonment of the latter. Should a commercial change occur, by which the price of coals should be again advanced to the high point reached two or three years ago, there might arise important advantages to these works and its customers, from the ability to make the substitution of wood for coal.

It will therefore be consistent with good policy to continue, as heretofore, the use of such number of wood retorts, as can be supplied with

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It will therefore be consistent with good policy to continue, as heretofore, the use of such number of wood retorts, as can be supplied with

that material, without sensibly affecting its market price, particularly as their use is accompanied by some immediate profit and entails no extra cost for the contingent advantages it presents.

A very careful and accurate analysis and photometric examination of wood gas have been made by two eminent analytical chemists (Dr. Wolcott Gibbs, of New York, and Dr. F. A. Genth, of Philadelphia), whose report of their chemical results furnishes a highly satisfactory explanation of certain curious phenomena that accompany the combustion of this gas.

They examined two varieties of gas, one made from old field pine, the other from small second growth oak, with the following results:

	Gas from Pine.	Gas from Oak.
Specific gravity,	0·663	0·580
Composition.		
Hydrogen,	32·71	30·44
Light Carb. Hydrogen,	21·50	33·12
Olef. Gas and Hydro Carbon Vapors,	10·57	6·46
Carbonic Oxide,	27·11	26·11
Carbonic Acid,	4·90	0·48
Oxygen,	0·66	None.
Nitrogen,	2·55	3·39
	100·00	100·00

These gases were collected at the Ninth Ward works, and taken to New York for analysis. Their illuminating power was tested and found to be over 26 candles for a five feet burner.

A subsequent series of photometric trials of wood gas, previously passed through a long pipe exposed to a temperature of 15° F., gave an average of 18·3 candles from a burner consuming 4·6 feet per hour.

The conclusion at which these gentlemen arrive from their elaborate examination is, "that wood gas, in illuminating power, is fully equal to the average of coal gas."

The growing magnitude of the operations, at the different offices and works managed under the gas trust, and their constant mutual dependence, have created a necessity for frequent intercommunication of intelligence, and official directions, such as can be most perfectly obtained, only by means of the magnetic telegraph. No time, therefore, has been lost in carrying into effect the recent directions of the Board upon this subject; and the contractor is moving so promptly, that the line will very soon be in readiness for use.

Of the advantages to be derived from this, it is not easy to form in advance anything like an adequate estimate. In the management and control of the numerous gas-holders, many miles apart, but in close mechanical connexion, it will add greatly to their security. In the regulation of the street main pressure, at various points during the hours of lighting, it will prevent the inconveniences that now so frequently result from the want of prompt information at the Works. In regulating the lighting and extinguishing of the public lamps, in giving a knowledge of the exact locality of fires, and in a vast number of other matters, it will be truly of inestimable value.

For the Journal of the Franklin Institute.

Practical Remarks on the Saturation of Marine Boilers. By James H. Warner, Eng. Corps, U. S. N.

The evaporation of water and formation of steam in the boiler of a steam engine, is analogous to the ordinary process of distillation. The principal object of such process, being to separate and collect the more volatile of any two fluids that may be mixed together, and the operation is founded upon the difference in the boiling points of such fluids. If water be evaporated, and the vapor condensed in a separate vessel, the distilled water will be perfectly pure, as the non-volatile, earthy or saline matter does not pass off with the vapor; and if it were possible to supply steam boilers with pure water, there would of course be no sediment or deposit; but such is seldom and perhaps never the case, as all water available for such purpose, contains more or less of vegetable, earthy, or saline matter.

Ocean and other steamers plying in salt water, necessarily use it for the generation of steam, and steam from salt water being fresh, the saline matter remains within the boiler, as in the process of distillation.

Sea water from various localities, has been found to contain slightly varied proportions of salt and other substances, and the average is generally assumed to be 3 parts in 100 parts of water, or about 1 pound of such matter in 33 pounds of water; and when referring to the density of sea water, we say it is $\frac{1}{33}$, or more frequently $\frac{1}{32}$. According to an approved analysis, 10,000 parts of sea water contains:—

Chloride of sodium,	220·01	$= \frac{1}{46}$
Sulphate of soda,	33·16	$= \frac{1}{302}$
Muriate of magnesia,	42·08	$= \frac{1}{238}$
Sulphate of lime,	7·84	$= \frac{1}{1276}$

This analysis affords the practical engineer no indication as to the nature of the deposit upon the interior surfaces of a boiler, technically known as "scale." Of the above constituents, chloride of sodium, or muriate of soda, is a salt of an alkali-metal, consisting of chlorine and sodium, or muriatic acid saturated with soda, and is simply common salt. Sulphate of soda is found in various mineral waters, although it is readily prepared from common salt, and was formerly used as a medicine, under the name of *Glauber salts*. Muriate of magnesia, is a salt of an alkaline earth, and is readily converted into sulphate of magnesia or *Epsom salts*, a well known purgative medicine. It is the presence of this salt that causes the bitter taste of sea water, and it vitiates the quality of the salt made in process of natural evaporation.

Sulphate of lime or *Gypsum*, is of frequent occurrence in nature, in some places forming entire ranges of hills, and is an important staple of commerce. It is occasionally found in spring water, but all natural salt water contains it in solution, and from the fact of its being very sparingly soluble, it is the first of the salts deposited in a marine boiler, constituting the principal ingredient of scale.

Of the different waters, southern seas are reputed to contain more of foreign substances than those of northern latitudes; at least it is supposed

that a deposit is made and scale formed sooner and more abundantly in some portions of our southern waters. This may in a great measure, be attributed to the extensive coral formations abounding in such districts, from which the water may derive additional quantities of the salts of lime, inducing precipitation at lower degrees of saturation and temperature. But the Arctic seas really contain a much greater proportion of salt than other waters, consequent upon the immense mountains of ice formed in those regions, and from the fact that ice from salt water is fresh, all impurities being separated in process of freezing or evaporation.

The boiling point of water will be raised in the event of chemical combination with any substance calculated to increase its density, and in a direct ratio with such increase, but foreign matter held only in mechanical suspension, does not affect the boiling point.

The following is an abstract from a table current in approved authorities, indicating the boiling point for different degrees of density, the mean atmospheric pressure being 29·998 inches of mercury:

Kind of Water.	Density.	Boiling point.	Increase of temperature.	Kind of deposit.
Pure fresh water,	0	212°		None.
Common sea water,	$\frac{1}{32}$	212°	1·2°	
	$\frac{2}{32}$	213·2	2·4	
	$\frac{3}{32}$	215·5	3·5	
	$\frac{4}{32}$	216·4	4·4	
	$\frac{5}{32}$	217·9	5·9	Sulphate of lime.
	$\frac{6}{32}$	219·1	7·1	
	$\frac{10}{32}$	223·8	11·8	
Saturated solution,	$\frac{12}{32}$	226·1	14·1	Common salt.

A deposit of sulphate of lime takes place, as we observe, far below the point of saturated solution, and at a comparatively moderate degree of concentration. Observing the actual process of evaporation, this early deposit becomes apparent. Each particle of water, coming in contact with the heated metallic surface, is immediately converted into steam, the pure water passing off in the form of vapor, whilst all foreign matter is separated from it, and will either be dissolved by the surrounding water, or held in suspension, and finally deposited upon the surfaces in contact. Common salt has the remarkable property of being equally soluble in *hot* or *cold* water, and to a degree of concentration that cannot exist in a marine boiler, without absolute destruction. But not so with the salts of lime, they are very sparingly soluble; half an ounce of water will dissolve but half a grain of sulphate of lime; the quantity of water thus required, increasing with the density.

Hence the salt when discharged from each particle of water, is immediately dissolved, whilst only a small portion of the salts of lime are thus taken up; they are, therefore, temporarily held in suspension, whilst they accumulate, and by means of currents, become diffused through the entire mass, and thence deposited upon all the surfaces

in contact with the water. The time required to produce this result depends upon the quantity and temperature of the water, incidental to the rate at which evaporation is going on within the boiler. Of boilers having an equal amount of heating surface, that which contains the greatest quantity of water, will be most easily managed in this respect.

Recent experiments made in France, would seem to indicate that with a temperature corresponding to about 100 pounds pressure, sea water ceases to hold any substance in solution. A supplementary apparatus was suggested, based upon this fact, and to be applied for the purpose of separating saline matter from the water previous to entering the boiler. However advantageous such arrangements might be if successful, practical experience has demonstrated that with the maximum pressure and temperature adopted in marine boilers, they can be maintained comparatively free from an injurious accumulation of scale.

The first successful sea steamers were not provided with means to prevent the excessive formation of deposit, and it was of frequent occurrence that the boilers became so clogged as to render it necessary to stop and clean them, even during short passages. This fact was then considered an insurmountable barrier to the successful application of steam to ocean navigation. The mitigation of this difficulty is due to Boulton and Watt, who devised means somewhat similar to that now in use for such purpose, that is, the system of "blowing off," or otherwise extracting constantly or at definite intervals a portion of the supersalted water sufficient to maintain a moderate degree of saltness.

Whilst evaporation is going on it would be impossible to keep the water at its original density, but in accordance with the preceding table, no deposit takes place until it has attained $\frac{5}{32}$, or about five times the natural density, whence the water might be kept at any point of saturation below $\frac{5}{32}$. But this table, which may be correct, is true only with water subjected to atmospheric pressure; the least increase above that pressure and corresponding temperature will hasten precipitation so far as the salts of lime are concerned. However, in practical experience, evaporating various kinds of water, and under different conditions of pressure and temperature, the exact point at which a deposit will be made is rather difficult of determination; it is, therefore, the best policy always to keep within a safe limit, which, under ordinary circumstances, should be under, rather than exceed $\frac{2}{32}$, a point easily maintained with proper care and attention.

If from a given quantity of sea water of the usual density, or $\frac{1}{32}$, we evaporate one-half, the density of the remaining half will be $\frac{2}{32}$, one-half of the original quantity containing the whole of the saline matter, and if the evaporation is continued until one-fourth remains, it will be $\frac{4}{32}$, and if to one-eighth $\frac{8}{32}$; the respective quantities of water being 1, $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{8}$, and the corresponding densities will be $\frac{1}{32}$, $\frac{2}{32}$, $\frac{4}{32}$, and $\frac{8}{32}$. But in the process of evaporation within a steam boiler, the original quantity of water must be preserved, consequently, we find it necessary to introduce a fresh supply equal to that which is evaporated, and as all the saline matter remains in the boiler, the whole mass will gradually increase in density. The ratio in which this increase takes place may be illustrated by the following method, when we will assume the

total quantity of water to be 100, and that we alternately evaporate and feed 50 parts.

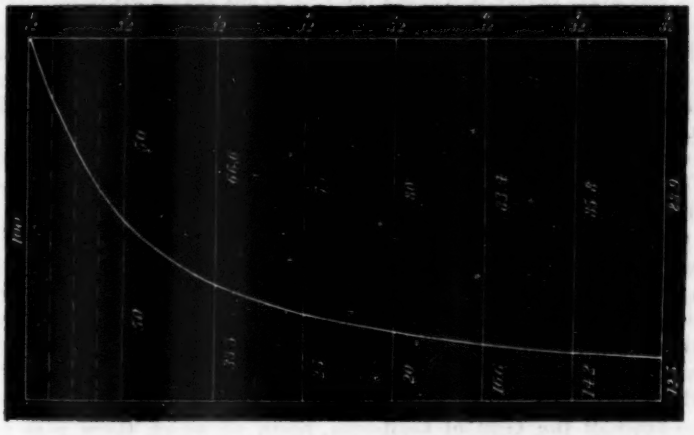
	Density.	Total.	Total.	Ratio.
Initial quantity,	100 $\frac{1}{3^1_2}$	100		$\frac{100}{50}=2$
Evaporate,	50		50	
Remaining,	50 $\frac{2}{3^1_2}$			
Feed,	50 $\frac{1}{3^1_2}$	150		
	100 $\frac{1\cdot5}{3^1_2}$			$\frac{150}{100}=1\cdot5$
Evaporate,	50		100	
	50 $\frac{3}{3^1_2}$			
Feed,	50 $\frac{1}{3^1_2}$	200		
	100 $\frac{2}{3^1_2}$			$\frac{200}{100}=1\cdot33$
Evaporate,	50		150	
	50 $\frac{4}{3^1_2}$			
Feed,	50 $\frac{1}{3^1_2}$	250		
	100 $\frac{2\cdot5}{3^1_2}$			$\frac{250}{200}=1\cdot25$
Evaporate,	50		200	
	50 $\frac{5}{3^1_2}$			
Feed,	50 $\frac{1}{3^1_2}$	300		
	100 $\frac{3}{3^1_2}$			$\frac{300}{250}=1\cdot20$
Evaporate,	50		250	
	50 $\frac{6}{3^1_2}$			
Feed,	50 $\frac{1}{3^1_2}$	250		
	100 $\frac{3\cdot5}{3^1_2}$			$\frac{350}{300}=1\cdot16$
Evaporate,	50		300	
	50 $\frac{7}{3^1_2}$			

Hence, assuming 1 to be the initial quantity of water supplied, the numbers 1, 5, 33, 25, 16, &c., indicate the proportional amount of water that must be "blown off," or otherwise extracted, or, in other words, to keep the water at its natural density, we should have to blow off 1, or the total amount supplied; to keep a density of $\frac{2}{3^1_2}$, one-half must be blown off, at $\frac{3}{3^1_2}$ one-third, at $\frac{4}{3^1_2}$ one-fourth, &c.

The rationale of this process may be further explained: suppose we have the given quantity of water 32 pounds, containing 1 pound of saline matter. If from this we evaporate 16 pounds, we have 16 pounds remaining, which contains the original quantity of salts, and consequently, has a density of $\frac{2}{3^1_2}$; then if we add to this 16 pounds at $\frac{1}{3^1_2}$, containing $\frac{1}{2}$ pound of salt, we have 32 pounds of water and $1\frac{1}{2}$ pounds

of saline matter, the density being $\frac{1.5}{32}$, with an increase of $\frac{1}{2}$—32. Repeating this operation, evaporating 16 pounds, there will remain 16 pounds of water and $1\frac{1}{2}$ pounds of salt, having a density of $\frac{3}{32}$; again supplying 16 pounds at $\frac{1}{32}$, we have 32 pounds of water and 2 of salts, corresponding to $\frac{2}{32}$. The density previous to this operation being $\frac{1.5}{32}$, the actual increase will be $\frac{1}{2}$—32, as before, but the *ratio* of increase will be as $1\frac{1}{2}$ to $\frac{1}{2}$ or $\frac{1}{3}$. If this process be continued, the density would increase successively $\frac{1}{2}$—32, whilst the ratio would be inverse, or as $1\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, &c. Hence, it is evident, that by blowing off a sufficient quantity of the supersalted water to *counteract* this ratio of increase, the density can be maintained within a desired limit. But we might here remark, that although we nominally "blow off" for the purpose of guarding against undue concentration, it is the *feed* that freshens the water in a boiler; we might blow off in vain but for the introduction of feed water which is comparatively fresh. Therefore, we feed an additional quantity, more than is required for evaporation, and *blow off the surplus.*

The following diagram illustrates the law, in connexion with the ratio,



between the amount of water evaporated and that blown off. That portion of the diagram included between the curve and its assymptotes, indicates the quantity blown off.

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*On the Geology and Physical Geography of North America.** By Prof. Henry D. Rogers, from the United States.

(Continued from page 230.)

D. The Great Western Desert Plateau.

Between the Rocky Mountains on the east, and the Pacific Alps, Cascade Chain, and Sierra Nevada on the west, there stretches from the Gulf of California to the Arctic Ocean, an elevated desert zone of great breadth and height, especially in its central section, between latitudes

* Notices of the Meetings of the Royal Institution of Great Britain, Feb. 8th, 1856.

35° and 45°, where its mean level above the sea is about 5000 feet. It consists of three principal regions,—the Central Desert Plateau, now indicated; a semi-desert area, south-east and south of this, the basin of the Rio Colorado, divided from it by the Wahsatch Mountains; and a northern region, that of the Columbia and Frazer's Rivers, sterile and rugged, separated from the central by the mountains south of the Columbia.

The Central Plateau, or Great Utah Desert, is an almost rainless region, parched by dry winds. The evaporation balancing the rain-fall, none of its scanty drainage passes to the sea, but each attenuated stream ends in a closed lake, the water of which is more or less salt. It is a vast elevated arid waste, containing wide plains encrusted with salt, a soil generally more or less saline, and large tracts of light volcanic scoriæ and ashes. Through its centre there runs, southward, a broad belt of straight mountain ridges, the Humboldt Mountains, composed in part of crystalline rocks, in part of carboniferous limestone, and other palæozoic strata. The chief stream is the Humboldt River, which, flowing west, dies away in the salt plain before it reaches the foot of the Sierra Nevada. There are twelve or fifteen salt lakes of considerable magnitude in this high insulated basin. The largest of these is the Great Mormon, or Utah Salt Lake, the waters of which are impregnated almost to saturation, containing 20 per cent. of common salt, and 2 per cent. only of other salts. Its length is seventy-five miles, and mean breadth about 30 miles.

The Southern Desert Basin, or that of the Rio Colorado, lying between the Rocky Mountains and the Wahsatch and Californian Mountains, is, like the Utah Desert, a succession of arid table lands and plains, intersected by rugged mountains. Its north-eastern portion is better fed with rain than its western; those tracts most under the lee of the intercepting barrier of the Pacific Mountains being more desiccated than the districts further removed. The Pacific Mountains are also less elevated in this latitude than further north, opposite the Central Desert. This Southern or Colorado Desert slopes gently southward to the ocean level at the head of the Gulf of California, north of which there is an arid tract of the surface, which is actually lower than the surface of the sea, believed to have a depression in its centre of 300 feet,—a region of continual depression, from which the dry winds have lapped up the remnant waters of the Gulf of California, and annually drink away every trace of the back waters of the Rio Colorado, at the season of its rise from the rains in the mountains. In some localities along the western edge of the Colorado Desert, the rounded water-worn pebbles which strew the surface are beautifully polished, from the action of the sharp dry sand driven furiously over the gravelly pavement by the prevailing westerly winds; and in several of the gorges or passes through the Sierra Nevada, in the same neighborhood, the fixed rocks of the mountains are themselves smoothed and striated by the same agency.

E. The Pacific Mountain Chain.

The third, or western belt, of the great elevated mountain zone of Western North America, is the oceanic chain which runs adjacent to

the Pacific from Russian America to the peninsula of Lower California. The northern section of this chain traversing Russia and British America, is sometimes called the Pacific Alps; the middle section, from Frazer's River to the Klamath, the Cascade Range; and the southern section, lapping past part of the southern end of the latter, and extending from the Columbia River to about lat. 35°, and becoming extinct in the San Bernadino country, is called the Sierra Nevada. The central ridge of the peninsula of Lower California, a part of the same great Pacific chain, is the southward prolongation of a parallel mountain axis, which, in Middle and Northern California ranges parallel to the Sierra Nevada, west of it, and close to the Pacific coast, and is there known as the Coast Mountains. Low in its southern sections, this great mountain chain in Middle California, Oregon, and Russian America is broad, complex, and very lofty, its main central crests containing nearly the highest summits upon the continent. The Sierra Nevada, a great water-shed insulating the high rainless plateau of Utah from the basin of California and from the sea, carries a very elevated crest, many parts of which reach a height of 10,000 feet; but it has few insulated peaks towering above this line. The Cascade range, on the contrary, wholly different in its geological structure, being largely volcanic, is cleft nearly to the sea level in many places, and yet bears some of the most colossal conical summits to be met with on the globe. The three great volcanic peaks, Mount Jefferson, Mount Hood, and Mount St. Helen's, tower in great masses to the height of 15,500 feet, and even above this. Mount Fair-weather, 14,782 feet high, and Mount St. Elias 17,850 feet, are both volcanoes, believed to be occasionally active; while Mount St. Helen's and Mount Regnier, though rather torpid, are known to be occasionally in eruption. About latitude 35°, the Sierra Nevada and the coast range diverge northward, to enclose between them the gold-producing valley of California.

The geological constitution of the Pacific chain differs in its different sections. The Sierra Nevada, peninsular chain and coast mountains, consists largely of the azoic or semi-crystalline strata, with belts of the gneissic and true plutonic rocks, in some parts of their higher crests, and in less proportion, the older palæozoic rocks low upon their flanks. The Cascade chain, commencing in the huge extinct volcano Mount Shaste, and crossing the Klamath, Columbia, and Frazer rivers, dividing the northern desert from the Pacific slope, is composed entirely of comparatively recent volcanic emissions, though in some tracts it contains also belts of the older crystalline rocks. This mixed volcanic and plutonic character appears to characterize this chain throughout its long course into Russian America.

F. The Pacific or Western Slope.

Between the great Pacific chain and the western shore of the continent there extends the very long and comparatively narrow Pacific slope, everywhere declining, more or less steeply, to the sea. Slender in the California peninsula, it widens north of lat. 34° to admit the coast mountains and the gold-bearing valley of upper California, here presenting three subordinate belts, covering a breadth of about 100 miles, which

dimension it maintains to Vancouver's Island, and beyond it. From the valley of the Sacramento, northward, its surface becomes more rugged.

The geological constitution of the Pacific slope is considerably more diversified than that of the Atlantic slope, descending eastward from the Appalachians. It consists generally of tertiary strata, mainly of miocene age: eocene, pliocene, and pleistocene, having also been recognised. These tertiaries are generally undulated and broken from violent crust movements, and in some quarters they are extensively penetrated by eruptive volcanic rocks; in other tracts the older azoic and palæozoic rocks, and still more ancient gneissic strata, forming the spurs of the coast range, intrude themselves through the tertiaries, which have probably been deposited around these ancient masses while they were above the waters.

G. The Atlantic or Eastern Slope.

This long and slender zone stretches from the Gulf of St. Lawrence to the Gulf of Mexico, and descends with a gentle lateral slope from the base of the Appalachians to the Atlantic coast. Its several subordinate belts differ both in physical features and geological structure. One subdivision, ranging from the Gulf of St. Lawrence to the Hudson, through New Brunswick and New England, has a hilly surface, and many rivers, which meet the tidal level far inland from the sea. It contains short chains of rounded hills, some of them mountains in size, and it is spotted with a multitude of clear lakes and ponds, and it is throughout admirably watered. This region forms one general slope to the sea, not being fringed on its ocean border, as the corresponding zone further south is, by a true tide-water tertiary plain.

In its geological composition, this north-eastern division of the Atlantic slope consists generally of the older crystalline rocks, with palæozoic strata resting upon them. Its entire surface is covered with northern pleistocene drift, to so great a depth in some tracts as effectually to conceal the formations underneath. The limpidness of its streams and lakes must be attributed mainly to the filtering action of this sandy and gravelly bolder drift, which contains but little dispersed clay, though beds of pure brick clay regularly stratified do occasionally occur in it.

The south-western section of the Atlantic slope, expanding southwestward from the Hudson, attains in Virginia a width of at least 200 miles, under which it continues to the southern end of the Appalachians. It includes two parallel belts, quite distinct in their geology and scenery; that nearest the mountains is a true slope, descending from a height of several hundred feet to the level of the tide; that bordering the sea is a low monotonous and very level plain. Between the slope and the plain runs a well defined line of demarcation, indicated in a sudden change in the topography, and in the abrupt transition in all the streams, from rapids to the ebb and flow of the tide. Upon this physical boundary are seated all the chief cities of the Atlantic sea-board, from Trenton, in New Jersey, to Halifax, in North Carolina. This line marks, indeed, an ancient sea coast of the earlier continent in the times anterior to the elevation of the horizontal tertiary deposits.

The upper, or Appalachian division of the Atlantic slope, traced south-

westward, ascends from the level of the tide at the Hudson, to its maximum height of 1000 feet near the sources of the Roanoke, and declines again beyond the Catawba, to a more moderate level in middle Alabama. From Long Island Sound to the Potomac its surface is varied and pleasing, and its soil very fertile.

Geologically, this belt includes tracts of the gneissic series, and synclinal troughs of the most ancient palæozoic formations—all in a more or less metamorphic condition. These are overlaid by a zone of middle secondary red sandstone, of older Jurassic age. This zone embraces low rugged wooden ridges, and hills of trapean and other gneous rocks. It possesses many broad, fruitful, and salubrious valleys; is singularly well watered by clear running brooks, but is nowhere marshy, and is altogether the garden spot of the Atlantic border of the continent.

From the Potomac, south-westward, the features of this slope are more monotonous, the soil less fertile, consisting of light sands and meagre clays, produced from the subjacent talcose and chloritic schists, and other altered azoic rocks. The climate is less temperate, being liable to great heat in summer, and to heavy rains, which wash its pulverulent soil. These conditions of soil and climate impart excessive turbidness to its swiftly flowing streams, causing indirectly extensive sand bars and shoals at the mouths of its rivers and estuaries, tending to block the navigation. Immediately at the base of the blue ridge, in Virginia and North Carolina, this region contains highly fertile and picturesque tracts.

The Atlantic Plain, or sea-board belt of the Atlantic slope, nowhere rises above 100 feet from the ocean level. From Long Island to North Carolina, though intersected by many tidal creeks, it is not marshy, except near the ocean, and bordering the estuaries of the Delaware and Chesapeake; but farther to the south-west, through North and South Carolina, Georgia, and Florida, its seaward half is excessively swampy and much overflowed.

Geologically, this ocean border is composed exclusively of cretaceous and tertiary deposits: the former consisting of clays and sands, including thick wide spread beds of pulverulent green sand, greatly valued as a fertilizer for the soil; the latter or tertiary of sands, clays, and beds of shell marl, with few or no concreted rocky layers. The cretaceous strata outcrop along the continental side of this plain in a narrow zone, extending from the northern sea coast of New Jersey to the Chesapeake, and reappear again low upon some of the rivers of the Carolinas and Georgia; but, throughout a large part of the plain, they are deeply covered by the tertiaries. The eocene tertiary strata have a narrow long line of outcrop in a corresponding position along the western edge of the plain, from the Potomac to the Cape Fear River; they reappear again from under the middle tertiary beds, in a more central position in the plain, from the Cape Fear River to the Altamaha. Still farther to the south-west, these eocene beds fringe the southern edge of the cretaceous regions of Georgia, Alabama, and Mississippi, south of the termination of the Appalachian Mountains. This wide southern tract of eocene extends southwards into the interior of the peninsula of Florida, showing this peninsula to have originated as early at least as the morning period of the tertiary day.

The miocene tertiaries cover nearly the whole of the tide-water plain, except the narrow eocene strip on the west, and a pliocene area on the sea coast of Virginia and North Carolina, from southern New Jersey, through Delaware, Maryland, Virginia, and North Carolina.

The pliocene deposits skirt at intervals, the entire Atlantic sea coast from the Chesapeake to Florida, and also the whole coast of the Gulf of Mexico, from Florida to Texas; forming, for the most part, a fringe to the eocine beds, the miocene not having been deposited in these regions.

Geological Features of the United States.

Turning, next, to a more special description of the geological features of the United States, the speaker sketched briefly the great natural areas occupied by its separate formations.

1st. To the north of the east and west Lawrentine watershed, which itself consists generally of the ancient crystalline rocks, including the older metamorphic or gneissic, later metamorphic or azoic, or non-fossiliferous palæozoic strata, and many plutonic outbursts;—there extends to a high latitude, and filling a part of the natural hydrographic basin of Hudson Bay, an area or basin of fossiliferous palæzoic strata of the upper Silurian, Devonian, and possibly Carboniferous periods. This may be called the Hudson Bay, or Arctic Palæozoic Basin.

To the south of the before-mentioned Lawrentine igneous watershed, and westward from the Atlantic slope to the Rocky Mountains, and even to the great Pacific chain, and probably north-westward to the basin of Mackenzie River, there spreads another still larger palæozoic basin. The south-eastern and best developed part of this area, from the Appalachians to the plains of Kanzas and Nebraska, entitled the Appalachian Basin, includes formations of all the palæozoic periods known to geologists, from the dawn of life upon the globe, to the close of the age of the coal.

From this brief statement of the two basins, and an inspection of the geological map, it appears that the Appalachian Basin, or that south of the Lawrentian Lakes, was depressed or under water in the earlier palæozoic periods, while the region north of the Lawrentine watershed was above the level of the sea. But at the close of the Cambrian or older Silurian ages, that great disturbance of the crust, which let the ocean in upon the area of the present basin of Hudson Bay, for the production of the Silurian and later strata, lifted out a part, and shallowed other portions of the sea-bed of the other, or Appalachian Basin, to the south. This is manifested in a break in the sequence of the strata, wherever the older Silurian or Cambrian, and the later palæozoic rocks are there recognisable together.

The first stage, then, in the physical geography of the primeval North America, was the existence of a small northern continent, the southern coast of which was nearly coincident with the northern skirt of the present valley of the St. Lawrence and its lakes. This continent, or nucleus of one, sent forward to the south a long peninsular tract, the vestiges of which we may discern in the hypozoic and azoic belt of the Atlantic slope, stretching from New Brunswick to Georgia. Very possibly other lands lay to the eastward of this region of the Atlantic slope at that early

date, and were depressed during some of the earlier oscillations of the crust in this quarter of the hemisphere; the seeming eastern origin of many of the Appalachian palæozoic strata, to the coal rocks inclusive, is eminently suggestive of the existence in the palæozoic times, of some such large tract of land, and ancient Atlantis, now under the bed of the western part of the Atlantic.

The next general movement of the crust, in the region now constituting the eastern half of North America, was at the end of the coal period, manifestly an epoch of very extensive uplift of the continent. This shift of level, and total drainage of the eastern half of the Appalachian sea-bed, caused a large accession to the continent, the new shore of which, if assumed to be coincident with the line which now separates the palæozoic Appalachian formations, and yet older ones of the Atlantic slope, from the later horizontal cretaceous and tertiary deposits that fringe them, was that well marked physical limit already partially traced as the inner edge of the low tertiary and cretaceous plain. Probably, however, this newly-produced part of the continent, particularly on its western side, was somewhat more extended at the date of elevation than the present margin of the cretaceous formation indicates; for it is upon this supposition, coupled with a belief that the newly uplifted formations remained out of water, under somewhat wider boundaries than they now exhibit, that we can best explain the non-existence of any Permian and Triassic formations between the Carboniferous, the latest of the American palæozoics, and the Cretaceous, the next more recent sediments deposited against them. During all the long geological ages which intervened between the lifting out the palæozoic region of the United States east of the Missouri, and the deposition of the Cretaceous strata, no sedimentary formations of the Mesozoic periods, such as those which fill large tracts in other quarters of the globe, were permanently upraised into dry land, saving only a few narrow strips —products of estuary sedimentation—stretching at intervals along the Atlantic slope from Prince Edward's Island to Carolina. Elsewhere, certainly as far westward as the Rocky Mountains, either nothing was deposited during the permian, triassic, and jurassic ages, or, what is far more probable, the formations then produced were formed outside of the present palæozoic limits, and have been covered up from sight by the wider sediments of the cretaceous sea, which, lapping over them, have shut in all the earliest border tracts of the palæozoic lands, formed at the end of the coal period.

The nature of the crust movements which elevated the palæozoic strata was in the region of maximum disturbance—that of the Atlantic slope and Appalachian chain,—a stupendous undulation or wave-like pulsation, the strata being elevated into permanent anticlinal and synclinal flexures remarkable for their wave-like parallelism, and for their steady declining gradation of curvature, when they are compared in any east and west section across the corrugated zone. To the westward of the Appalachian chain, where this structure is so conspicuous, the crust waves flatten out, recede from each other, and vanish into general horizontality; and this nearly level condition extends thence throughout

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all the older rocks to the plains of Texas and Nebraska, where the cretaceous beds overlap them. The orographic features of the Appalachian chain, even to the minutest slopes and terraces upon the flanks of the ridges, are all beautifully impressive of the carving action of deep retreating waters.

The cretaceous deposits of the United States all imply a marine origin, no fresh water remains having hitherto been discovered among them; and the geological map now exhibited pictures approximately the wide extent of the cretaceous, or later mesozoic sea, as it washed the boundaries of the palæozoic continent. The shore of that sea was, as before hinted, the inner edge of the Atlantic plain on the east; on the south it was the southern termination of the Appalachian chain and the other great north-east and south-west palæozoic tract, west of the present Mississippi; and on the west, for a long distance northward, it coincided generally with the present valley of the Upper Missouri. This cretaceous sea lapped round the southern end of the Rocky Mountains, and spread as far to the west as the Cordilleras of New Mexico and the Wahsatch chain of Utah. We do not at present know that it extended any further.

The close of the cretaceous or chalk period was marked by the rise and desiccation of nearly the whole now continental area of this great northern Mediterranean. The movement along the Atlantic border of the continent was comparatively slight, for it brought above the sea level only very limited and narrow tracts of the shoal water cretaceous sediments. South of the Appalachian region it was somewhat more extensive, elevating a wider zone between the previous dry land and the newly formed tertiary shore; but to the west of the region of older rocks it was a broad continental rising, draining dry nearly the whole bed of the then existing ocean to the limit indicated beyond the Rocky Mountains. The coast line established by this lift of the crust, set new and much more restricted bounds westward and northward to the Atlantic Ocean, and established the outlines of the present Gulf of Mexico, which thus dates back as far as the commencement of the eocene tertiary age. It does not seem probable that Florida was then any part of the dry land, the true southern peninsula of the continent being rather the newly formed cretaceous plain at the end of the Appalanchians.

From that date, the movements in the level of the continent have been manifestly less and less. Its great outlines, established at the close of the chalk period, have remained as its contour to the present day; and each successive gain of territory, during the several tertiary revolutions —that which ended the eocene, that which closed the miocene, and that which cut-off the pliocene, and even the pleistocene deposits, was but an enlargement of the primitive mesozoic pattern, a mere addition of a lighter and lighter fringe to the broad mantle of land, which earlier convulsions had constructed.

(To be Continued.)

AMERICAN PATENTS.

List of American Patents which issued from March 10th, to March 31st, 1857, (inclusive,) with Exemplifications.

MARCH 10.

73. For an *Improvement in Stop Motions for Steam;* John T. Ackley, Philadelphia, Pennsylvania.

Claim.—"The rod with its nuts, in combination with the spring lever having two fulcrums, and the spring catch lever, the said rod being operated (in case of accident,) by the cross-head of the steam engine, or other convenient working part of the same, and the said catch lever being connected to the eccentric rod, or to a stop-valve in the steam pipe."

74. For an *Improvement in Cut-offs of Steam Engines;* John F. Allen, City of New York.

"This invention consists in a certian mode of applying and operating the cut-off of a slide valve engine, for the purpose of cutting off the steam instantaneously, without any previous unnecessary contraction of the opening of the port at any point between the commencement of the stroke and the half-stroke of the piston."

Claim.—"1st, The arrangement of the sliding cut-off valves to work on a separate seat, arranged inside of the seat of the main valve, and having precisely similar arrangement of ports to the seat of the main slide valve. 2d, The foot pieces and levers attached to opposite ends of the main slide valve, and operating in connexion with pistons that are attached to the cut-off valves, and work in cylinders connected with the main steam passages, and with spring catches that retain the said pistons and adjustable sliding pieces, or their equivalents."

75. For an *Improved Machine for Grinding Saws;* Emanuel Andrews, Elmira, New York.

"The nature of my invention consists in the use of two stones, in combination with the rollers, for the purpose of grinding on a taper—each stone acting independent of the other—the saw revolving faster when the stones are at or near the centre, than when at the edge of the same."

Claim.—"1st, Connecting the saw to the mandrel by the ball joint, for the purpose of adjusting it to the position of the rollers while being operated on by the stones, whether these act conjointly or independently, and to prevent straining the saw. 2d, The plate, for the purpose of allowing me to guide and grind a saw even in thickness, regardless of its hard or soft parts, thus perfectly balancing the saw."

76. For an *Improvement in Manufacture of Felt Cloth;* George G. Bishop, Norwalk, Connecticut.

Claim.—"In contradistinction from forming a bat for felt cloth, by carding from laps a bat made from ropings or rovings."

77. For an *Improvement in Casting Plates for Artificial Teeth of Alloys;* Alfred A. Blandy, Baltimore, Maryland; ante-dated Dec. 11, 1856.

Claim.—"Casting the plates of artificial teeth of an alloy suitable for such a purpose from its chemical and physical properties, and that practically will not shrink or expand on solidifying."

78. For an *Improvement in Converting a Lifting Pump into a Suction and Forcing Pump, or vice versa;* John F. Brickley, Winchester, Indiana.

Claim.—"So arranging a rod in connexion with the valve of the pump, as that said valve may be closed or opened at pleasure by the user, for converting an ordinary lifting pump into a suction and forcing pump, or vice versa."

79. For an *Improvement in Melodeons;* Riley Burditt and Hatsell P. Green, Brattleboro', Vermont.

Claim.—"Having the fulcrum of all the connecting levers located upon a single movable board."

80. For an *Improvement in Rock Drills;* Thomas H. Burridge, St. Louis, Missouri.

Claim.—"The combination of the sliding head with the ratchet guide piece, bumper spring, rod, and drill bar, when said parts are constructed and arranged for joint operation."

81. For an *Improvement in Harvesters;* Hiram Clark, Rochester, New York.

Claim.—"Giving to each of the cutting bars alternately, an advancing upward stroke against the grain."

82. For an *Improvement in Machines for Harvesting Grain;* George R. Crane, Caldwell, New Jersey.

Claim.—"Operating the bars to which the rake teeth are attached, from left to right, by means of the straps, roller, cord, and spring, when the same are constructed and arranged in relation to each other within the divider or shield."

83. For an *Improvement in Machinery for Making Wire Rope;* Joseph Cushman, Racine, Wisconsin.

Claim.—"1st, The arrangement of the two sets of reels, in combination with the carriage, whereby the strands may all be adjusted and drawn out to the proper length simultaneously. 2d, The swinging arms, in combination with the traveling top."

84. For *Improved Devices for Raising or Lowering Farm Gates, to allow them to open over obstacles;* Dennis E. Fenn, Tallmadge, Ohio.

Claim.—"The section with the slot, spring, stud, section, arm, and the notched plate. Also, the slide and pawl."

85. For an *Improved Escutcheon for Key-holes;* Edmund Field, Greenwich, Conn.

Claim.—"The key-hole drop, composed of two parts pivoted together."

86. For an *Improved Method of Preventing Dust, &c., from entering the Windows of Railroad Cars;* Philip M. Pyfer, Baltimore, Maryland.

Claim.—"The arrangement of rotary fans, or their equivalents, upon the outside of the body of the car, when employed in conjunction with the windows thereof."

87. For an *Improvement in Steam Spades;* George Morton Ramsay, City of N. York.

Claim.—"The alternate spades, in combination with the double crank shafts."

88. For an *Improved Guard for Breast-Pins;* James M. Ross, Springfield, Mass.

Claim.—"The additional guard as applied."

89. For an *Improvement in Valve Gear of Direct-action Steam Engines;* James P. Ross, Lewisburgh, Pennsylvania.

Claim.—"The elastic lever, applied and operating in combination with the oscillating yoke, the traveler, and the roller, or its equivalent."

90. For *Improved Fluid Gates or Faucets;* Jared W. Smith, Hartford, Conn.

Claim.—"The slide, guided, secured and made adjustable by the screw-pin and nut, having a guiding flanch to travel within guide strips, when the same are used in connexion with an operating lever, loosely connected by recess with said slide for the more convenient removal of the parts and retention of the slide in case of breakage of the lever, and for the more free and independent operation of the parts, and so that the bolt holds the slide without the aid of the lever. Also, in combination of the lever and slide, or therewith the fulcrums, at different distances from the centre of the slide and slotted arm."

91. For an *Improved Chuck for Watchmakers' Lathes;* William Stephens, Richmond, Indiana.

Claim.—"The sliding or adjustable jaws, in combination with the sliding or adjustable back centre rod."

92. For an *Improved Table Gauge for Circular Sawing Machines;* M. B. Tidey, Ithaca, New York.

Claim.—"The construction of a portable saw gauge."

93. For an *Improved Mode of Supporting the Tongues of Coaches;* Zalmon B. Wakeman, Beloit, Wisconsin.

Claim.—"The use of the brace or braces, or their equivalents, attached to the reach

(or perch) of a wagon, or other carriage, in combination with a spiral spring or spiral springs applied to the tongue of a wagon, or other carriage, and pressing against the reach for the purpose of giving direction and steadiness to the tongue by checking its motion sidewise, keeping it in a straight line with the reach (or perch,) while it supports it, and also preserves the set of axle in its true position. Also, the arrangement and combination of parts, for the purpose of giving direction and steadiness to the tongue while it supports it."

94. For an *Improved Circular Sawing Machine;* C. P. S. Wardwell, Lake Village, New Hampshire.

Claim.—"The arrangement of two or more saws or cutters in a swinging frame, so that either saw or cutter may be brought into a suitable position for action, while at the same time the other or others shall be removed from the way, in the manner specified or in any equivalent manner: and this I claim whether or not a central or axial saw or cutter is combined therewith, or with a single swinging saw or cutter."

95. For an *Improvement in Grain Cradles;* Samuel D. Warren, Lebanon, Alabama.

Claim.—"The combination of the standards, fingers, and sneed, when so made and united as that by the bar, said fingers may be gathered or adjusted."

96. For an *Improved Method of operating the Splitting Knife in Hoop Pole Machines;* Carver Washburn, Bridgewater, Massachusetts.

Claim.—"The improvement of applying a knife to the feed rollers, or the latter to the former, so that one may be made to approach towards and recede from the other."

97. For an *Improvement in Machines for Stamping Figures in Carpenter's Squares;* Heman Whipple, Shaftsbury, Vermont.

Claim.—"1st, The arrangement of a series of chase bars jointed at one side of the machine, when combined with the anvil sustaining the square, and with the hand-wheel, rack, or racks, and pawl, for regulating the relative positions of the anvil and chase bars. 2d, The arrangement of the levers, and bolt, bars, and slot, and pin, whereby the one motion of the lever (by the treadle,) first turns the bar around to confine the chase bar, and then gives the requisite compression of the chase bar at both ends on to the square or plate on the anvil, to retain the same firmly, while the chases are being separately struck into said squares."

98. For an *Improved Self-Regulating Wind-Wheel;* Abner P. Wilson, Salem, Ill.

Claim.—"Constructing the sails of two parts attached or fitted to inclined frames which are secured to the arms, the upper parts of the sails being hinged to their frames, and having weights and cords attached."

99. For an *Improved Bomb for Killing Whales;* Nathan Scholfield, Assignor to self and Wm. W. Wright, Norwich, Connecticut.

Claim.—"1st, Inserting the end of the fuse through a short holding pipe or collar, and securing it firmly therein by compressing the same, and the drawing or forcing this within the end of the fuse pipe, having a conical enlargement at its rear end. 2d, Enlarging the end fuse cord by winding it with twine, or its equiavalent, so that it cannot be drawn through the pipe, and inserting it in the fuse pipe either with or without the fastening pipe, and the putting gypsum, brimstone, or wax around it, within the nut, to hold it securely. 3d, The application of the sliding collar on a projectile carrying a cylindric metallic plate covering the projectile, and either slit to form wings, or unslit as a cylindric case, and so constructed that the said collar, with the case or wings, shall slide to the rear, after being discharged from the gun either by the action of a spring or the resistance of the air to guide its direction. 4th, So constructing and applying these wings, that they may coincide with the cylindric surface of the projectile while in the gun, and that their rear ends may be thrown up therefrom by their elasticity after being discharged, so as to stand in position diverging from that surface in the rear."

100. For an *Improved Device by which the Spigot of Gas Cocks may be Lubricated in their Seats;* Charles H. Johnson, Assignor to self and James G. Hamblin, Boston, Massachusetts.

Claim.—"When the tapering plug of the faucet or stop-cock is drawn into the tubular seat by the action of the spring combining with the seat tube an entrance passage and groove, and a movable stop, arranged so as to enable a person to expeditiously lubricate the stop-cock without the necessity of entirely removing its plug from its seat tube."

101. For a *Second Anchor Shackle;* George Gilmour, Assignor to self and Henry R. Clinkard, Chelsea, Massachusetts.

Claim.—"My new or improved anchor shackle, as made with a spring pawl and trigger, or latching apparatus, arranged in reference to the roller. Also, making the pawl forked or with a recess, so as to enable it to straddle the chain."

102. For an *Improved Machine for Coiling Steel Springs;* Perry G. Gardner, City of New York.

Claim.—"1st, The cone mandrel constructed in two pieces, so that the spiral cone will slide off and upon the straight part of the mandrel, the straight part having the slot or groove, and being an eccentric, so that one edge of the slot will be lower than the other, and gradually rising round to the other edge or side of the mandrel. 2d, The construction and arrangement of the sliding frame, for carrying or feeding up the steel plate upon the cone mandrel, and having attached to it the table, self-adjustable to any required inclination, for supporting and holding the steel plate while being drawn in upon the mandrel, and sustaining the adjustable rollers with their adjustments to meet any required thickness of the steel plate. 3d, The arrangement of the loose or sliding pressure roller, so as to have the lateral motion upon the axle by means of the arms attached to the sliding frame, and the simultaneous graduated downward movement to press and guide the steel plate upon the spiral cone. 4th, The combination of the sliding frame and the parts attached to it, and the pressure roller, and the intermediate guide plate, with the cone mandrel arranged and operating in a direct motion. 5th, The arrangement by which the wheel is thrown in and out of gear so as to connect or disconnect the shaft, with the shaft by which connexion or disconnexion may be made by hand, or by the operation of the machine itself at the required movement."

103. For an *Improved Machine for Shearing Steel Plates;* Perry G. Gardner, City of New York.

Claim.—"The arrangement of the movable bracket plate, so as to adjust the lower steel cutter to the upper steel cutter as required, the adjustable stop or guide plates, and the guide bars upon the tables attached to the eccentric lever, the whole combined, arranged, and operating in connexion with the shears."

104. For an *Improved Method of Operating Saw-mill Dogs;* George W. Hearn, Princess Ann, Maryland.

Claim.—"The longitudinally moving shaft, in combination with the shaft and the clutches."

105. For an *Improvement in Lubricators for Steam Engine Cylinders;* John Henwood, City of New York.

Claim.—"The piston having the oil cup attached by a hollow stem, and provided with a valve working in an oil cylinder, that is provided with an arrangement of passages leading to the steam cylinder valve chest, or other part to be lubricated, and with a cock, having an arrangement of passages to correspond with said passages from the oil cylinder."

106. For an *Improved Nipple for Discharging or Withdrawing Cartridges from Breech Loading Fire Arms;* Wm. Cleveland Hicks, New Haven, Conn.

Claim.—"1st, My improved nipples (two or more prongs with or without hooks for withdrawing loaded balls or cartridges from breech loading fire arms), for the purpose of igniting percussion, and discharging loaded balls or cartridges from breech loading fire arms. 2d, My method of using one, two, or more, nipples or prongs, with hooks to withdraw cartridges or loaded balls from breech loading fire arms, by causing said hooks to indent or spring the rim of a cap or primer, and by catching hold of said rim to withdraw the loaded ball or cartridge by the act of drawing back the nipples."

107. For an *Improvement in Enameling Cast Iron;* George W. Holley, Niagara, New York.

"The nature of my invention consists in providing what I call a skeleton or core plate for non-tubular surfaces, corresponding in surface as nearly as may be to the surface of the pattern which is to be moulded, in which mould, when prepared, the iron to be coated or covered with any given composition is to be cast. This skeleton or core plate is to be covered with sand, properly prepared with sour flour or molasses on the side on which it is proposed to coat or cover the cast iron plate with any given composition."

Claim.—"The process of covering the skeleton or core plate, and core rod, with the compound or composition with which it is proposed to coat or cover the iron, and then pouring the melted iron on and around said compound or composition, and melting or softening the same so that it well adhere to the surface of the iron as it becomes cold. The same process may be used for coating or covering copper, brass, and other metals."

108. For a *Fire-proof Stone;* Thomas Hodgson, Brooklyn, New York.

Claim.—"The useful manufacture of a fire-proof artificial stone, composed of feldspar, mica, and quartz, and the other substances or materials."

109. For an *Improved Machine for Forming the Curved Surface of Solid Wooden Chair Seats;* Edwin, Artemas, and Cheney Kilburn, Burlington, Vermont.

Claim.—"Shaping or hollowing out the faces or upper sides of chair seats, by means of a grinding or cutting wheel, when said wheel has a convex place or periphery coated with sand, emery, or other suitable substance, and using in conjunction with said wheel, the screw, or its equivalent, with the circular plate or disk attached."

110. For an *Improved Hydraulic Jack;* George Lindsay, City of New York.

Claim.—"The arrangement of them all combined, as constituting the specific whole machine."

111. For an *Improved Arrangement of Carriage Springs;* Charles A. McElroy, Delaware, Ohio.

Claim.—"The springs pivoted, and stirrups."

112. For an *Improved Machine for Cutting Screws;* Thompson Newbury, Taunton, Massachusetts.

Claim.—"The jointed elevator, passing through the bottom of the feed pan. Also, the vibrating slotted guide pace fixed to the carrier shaft, operated by arm and pin. Also, giving the threading tool for the purpose of pointing the blank, a motion independent of, and slower than, that required to effect the threading. Also, the catch-wheel with its pawl and stop, in combination with the leader worm."

113. For an *Improved Roller for Bending Sheet Metal;* Daniel Newton, Southington, Connecticut.

"The nature of my invention consists in preparing the outside roller for double seaming, with an angular groove turned into it, in which the seam runs in the first revolution, thus setting it down or pressing the seam together, and bending it over both at the same instant."

Claim.—"The application to double seaming machines of a roller containing an angular groove, in which the seam runs in the first revolution."

114. For an *Improved Carpenter's Plane;* Oldin Nichols, Lowell, Massachusetts.

Claim.—"Connecting the cap to the plane wire by the hook headed bolt, with two nuts, and thereon to hold them together, and then securing the iron to the plane stock by a cam shaft, operating upon this same hook headed bolt, which is so adjustable as to be lengthened or shortened, that any desired pressure may always be had to firmly hold the iron to the stock by turning the cam shaft, and still allow the plane iron to be moved in or out of the plane to cut a thick or thin shaving, without farther tightening or loosening it. Also, the plate secured to the plane stock, and intervening between the surface of the hook and the surface of the cam shaft, to prevent wear of the hook and cam, and also to prevent the hook and plane iron from sliding back when the cam shaft is turned to tighten the iron to the plane stock. Also, the application of one single handle to answer for, and be secured to, a whole set or any number of plane stocks, either in the lower or elevated position, and changeable from one position to another, or from one plane to another instantly, and be secured firmly thereto by means of the hook and cam, or their mechanical equivalents."

MARCH 17.

115. For an *Improvement in Enema-giving Apparatus;* Benjamin T. Babbitt, City of New York.

Claim.—"The combination of the portable reservoir, the flexible tube, and the nozzle, to form a portable apparatus, for the purpose of giving enemas or injections by hydrostatic pressure."

116. For an *Improvement in Machinery for Felting Hat Bodies;* James B. Blakslee, Newtown, and E. R. Barnes, Brookfield, Connecticut.

Claim.—"Giving to the endless rotating bed of felting machines, periods of rest during the continuous motion of the upper deck."

117. For an *Improvement in Power Looms;* John L. Cheney, Lowell, Mass.

Claim.—"My improved picker motion or mechanism, as made with a guard stand, and rocker, a stationary guide and a stud or roller, and with reference to the picker staff. Also, so arranging the top bearing surface of the stand of the rocker, that it may incline downward, and so as to obtain all the advantages of a spring, without the actual application or use of the same, meaning to claim such an arrangement of the top surface, with respect to the rocker and staff, as an improved equivalent to the spring."

118. For an *Improvement in Lard Lamps;* Isaac N. Coffin, Washington, D. C.

Claim.—"The combination of the flat inclined wick tubes, at right angles to each other, with the concave reflector."

119. For an *Improved Rotary Printing Press;* John C. Davis and Wm. Miller, Elizabeth, New Jersey.

Claim.—"The combination of the rollers with the shoes, and the inclination of the ways (or planes), and the upright screws for operating the type bed."

120. For an *Improved Mode of Veneering the Walls of Buildings;* George B. Field, St. Louis, Missouri, and Benjamin F. Field, Beloit, Wisconsin.

Claim.—"The mode or manner of securing these thin plates of slate or marble, to the walls and ceilings of buildings which have been previously built, meaning the combined arrangement of the strips of wood, cement, and screws, or the alternative method of the angle irons or window and door casings, pilasters, cornice string courses, or other ornamental attachments, combined with the cement, for the same purpose."

121. For an *Improvement in Telegraphic Repeaters;* Moses G. Farmer, Salem, Mass., and Asa F. Woodman, Portland, Maine.

Claim.—"The use of a mechanical obstacle, whereby, when the independent circuit has broken the dependent circuit at the instrument, the dependent circuit is prevented from breaking the independent circuit."

122. For an *Improved Bill Holder;* E. F. French, Franklin, Vermont.

Claim.—"The pockets placed between the two lids or covers; the pockets and lids being connected by a cord, and having a rod or axis passing through them at one end."

123. For an *Improved Gas Generator;* Alonzo M. Giles, Boston, Massachusetts.

Claim.—"The inner door operating whereby the heat of the retort is rendered much more intense and uniform. Also, the pipes, in combination with the inner door."

124. For an *Improved Hinge;* Kingston Goddard, Philadelphia, Pennsylvania.

Claim.—"The socket in the end (or adjusted to the end, so as to form the part thereof), of the hinge to be acted upon directly by a torsion bar—I claim only the hinges."

125. For an *Improvement in Piano Forte Action;* James A. Gray, Albany, New York.

Claim.—"The application of a spring to the hammer butt and jack-fly, causing the hammer to be so raised and kept in position that it will allow the jack-fly free play under the shoulder of the hammer butt, when the key is pressed down, and the action in motion. Also, the application of the hook to the hammer butt and jack-fly, so as to cause them to work together with more precision, and also to bring the hammer to its place after the key has been struck and released."

126. For an *Improvement in Machinery for Cleaning and Separating Cotton, Wool, Fur, and other Fibrous Materials;* Isaac Hayden, Lawrence, Mass.

Claim.—"Increasing the area of the trunk above the screen, or making it larger towards its rear end, by increasing its height or width, or both, as may be desirable, so that the blast of air which conveys the materials into or through the trunk, will move gradually slower, so as to allow the light and fine, or such portions as are intended to be separated, time to be precipitated and pass through the screen before the air, which holds them in suspension, escapes from or passes out of the trunk. Also, in combination with a trunk made gradually larger towards its rear end, I claim a screen of woven wire, or twine, arranged upon a series of partitions."

127. For an *Improvement in Machines for Stuffing Horse Collars;* Wade H. Haworth, Philadelphia, Pennsylvania.

Claim.—"1st, The employment of two stuffers, stuffing against each other from both ends of the collars, when such stuffers are made to recede automatically. 2d, The employment of two alternating sets of such stuffers, for stuffing both rolls of the collars."

128. For an *Improvement in Hernial Trusses;* Ancel I. Hardin, Shelby, N. C.

Claim.—"The position and application of the lever."

129. For an *Improvement in Harvesters;* Cornelius Holloway, Assignor to James B. Maney, Petersburgh, Va.

Claim.—"In combination with the cam connected to the frame by a link, and to the tongue by a strap or yoke, the slot at front, and the lever connexions at the rear, so that the machine may swing forward and back as it is lowered or raised, but be rigid when the draft is on."

130. For an *Improvement in Printing Presses;* Horace Hoft, Winchester, Mass.

"My invention consists in a peculiar arrangement of parts, whereby the 'form' is properly inked, the 'platen' drawn underneath the 'form', and the 'form' pressed down upon the card on the 'platen,' and the 'platen,' after the card has received its impression, is forced out from underneath the 'form.'"

Claim.—"Operating the platen by means of the cam, slide, and arm, connected with the 'platen' by the rod, and also operating the plate to which the form is attached by means of the rod connected with said plate, and made to bear against the face of the cam, when said parts are arranged so that the platen and form may be operated conjointly by the cam. Also, in combination with the means for operating the platen, the rotating and vibrating ink distributing roller. Also, throwing the printed card from the platen, by means of the levers attached respectively to the platen and plate."

131. For an *Improved Method of Cleansing Fibrous Materials;* John Howarth, Salem, Massachusetts.

Claim.—"The process of cleansing fibrous materials."

132. For an *Improvement in Brick Machines;* Almon V. Hough and Richard W. Jones, Green Castle, Indiana.

"The nature of our invention consists in the use and application of two horizontal shafts, within a perforated moulding chamber, having oval or flanched wings on one side, and arms or beaters on the other side, acting both as mixers and pressers, revolving together inversely, cutting off from above a sufficiency of mud to fill the moulds."

Claim.—"The use and application of two horizontal shafts, provided with oval or flanched wings on one side, and arms or beaters on the opposite side, in the lower perforated chamber, and in combination therewith, for the purpose of moulding and pressing the brick."

133. For an *Improvement in Harvesters;* Moses G. Hubbard, Penn Yan, New York.

Claim.—"A shifting seat, when constructed, arranged, and combined with a harvester."

134. For an *Improved Photographic Plate Vise;* John W. Jarboe, City of New York.

"This invention consists in a novel mode of applying and securing the movable jaw of a vise, which allows it to be moved any required distance to suit plates, or other articles of various sizes, and tightened upon the article in a very expeditious manner."

Claim.—"The combination of the screw and its attached cam with the movable jaw, and the sliding piece, the said jaw, and sliding piece, working in separate grooves, or their equivalents."

135. For an *Improved Mode of Compensating the Local Attraction of the Magnetic Needle on Ships;* Calvin Kline, City of New York.

Claim.—"The surrounding metallic ring or rings, or the modifications thereof, constructed, combined, and arranged with the needle of a compass."

136. For an *Improvement in Fire Arms;* Sewell K. Lovewell, Gardner, Mass.

Claim.—"The use of the spindle applied to guns of any size and calibre."

137. For an *Improvement in Convertible Cider Mill;* Samuel Males, Cincinnati, Ohio.

Claim.—"Rendering the machine readily convertible from a cider mill to a corn sheller, and vice versa, by making the concaves, hoppers, and cross beam, in the 'cylinder' and driving gear, being the same in both cases."

138. For an *Improvement in the Construction of Gas Burners;* John McHenry, Cincinnati, Ohio.

Claim.—"The removable disk as a means of varying the size of the throat of the burner."

139. For an *Improved Machine for Planing Tapering Staves;* Valentine Munck, Carrolton, Louisiana.

Claim.—"The adjustable table, and making said table guide with cutting head. Also, in combination with the table and cutting head, the angular side cutting heads, to secure from the variation of the table, tapered planing on the edges of the lumber."

140. For an *Improvement in Sewing Machines;* T. J. W. Robertson, City of New York.

Claim.—"Feeding the cloth in sewing machines by means of a hook having one or more points."

141. For an *Improvement in Cast Iron Car Wheels for Railroads;* James M. Ross, Springfield, Massachusetts.

Claim.—"My mode of constructing the plate, viz: by gradually increasing the thickness of the disk as it recedes from the hub and tread of the wheel."

142. For an *Improvement in the Burner of Burning Fluid Lamps;* Rufus W. Sargent, Philadelphia, Pennsylvania.

Claim.—"1st, The making of the chamber for the heating flame in lamps in which burning fluid, spirit gas, or other highly volatile fluid is used, so that it nearly or wholly surrounds the chamber in which the gas is generated, in order that the heating flame being sheltered from the outer air, and confined within the outer chamber, and in immediate contact with the inner chamber, may effect its purpose more steadily and with less consumption of fluid. 2d, Surrounding the burner tube with a wick and packing, in order to supply the heating flame with fluid, and the making of the burner tube with a flanch and shoulder, in order to afford space for said wick and packing, and the perforating the burner tube with apertures through which said wick may be supplied with fluid. 3d, The regulator movable up down upon the burner tube, in order to regulate and control the heating flame."

143. For an *Improved Machine for Cutting and Bending Sheet Metal;* Elliot Savage, East Berlin, Connecticut.

Claim.—"Constructing and arranging the frame which carries the clamps with respect to that which carries the cutters, that is, so that while the clamps are being forced together or made to seize a plate of metal, they shall not spread the cutters apart. Also, the mode of constructing the compound lever of the bending rollers, and arranging the rollers thereon; the said compound lever being composed of a bent lever and an arm, and the rollers being applied to them respectively. Also, combining with the clamps, their crank shaft and the bending rollers, the auxiliary crank shaft, or equivalent means, by which the bending roller may be rotated independently of force applied through the clamps, and so that the middle of the metallic plate shall not be subjected to injurious strains by the bending rollers."

144. For an *Improved Portable Reciprocating Circular Sawing Machine;* Osborne E. Stephens, McCall's Ferry, Penna.

Claim.—"A saw arranged to traverse horizontally, so as to cut a score in one side of the log to be sawed, and then moved perpendicularly, so as to traverse horizontally in the opposite direction, to cut a score in the opposite side of the log to correspond with, and cut into, the first score, and cut off a portion of the log. Also, the devices for changing automatically or by hand, the motion of the carriage which traverses the saw horizontally in each direction. Also, the devices for changing automatically, or by hand, the motion of the carriage that traverses the saw perpendicularly, Also, the latches arranged to fill the scores in the guide, so as to let it slip by the locking lever"

145. For an *Improvement in Mowing Machines;* John Taggart, Roxbury, Mass.

Claim.—"A series of rotary cutters, working in recesses or guides, in combination with a knife sharpener."

146. For an *Improvement in Metallic Seals;* Joseph Wappenstein, Philadelphia, Pa.

Claim.—"A metallic seal wafer or fastening for securing letters, packages, &c., composed of two pieces united together, and to the thing to be fastened."

147. For an *Improvement in Machines for Graduating Carpenters' Squares;* Heman Whipple, Shaftsbury, Vermont.

Claim.—"1st, The scale index mounted upon the carriage, and regulating the extent of motion given to said carriage from the truck and pusher point, whereby the length of the division mark is determined, and the cut made from the edge of the square. 2d, The arrangement of the rack lever, and its actuating cam or pin, pawl, rod, and weight, or its equivalent, for moving and adjusting the index to be acted on by the pusher. 3d, Arranging the graver stocks within the carriage, when said graver stocks are governed by the levers, adjusting rail, and springs and rods, or equivalents, for pressing down the gravers in cutting, and thus lifting the same up off the square while returning. 4th, The arrangement of the scroll cam, anvil, or bed, rod, lever, latch, incline wedge, and clutch or friction lever, for moving said bed and its square endwise, the required integral part between each stroke of the gravers, and then stopping the machine when the divisions are completed. 5th, The manner of securing the gravers in place, and bringing them to the exact position in the stocks by means of the mortise bolt."

148. For an *Improvement in Machines for Unmaking Rope or Cordage;* Joseph Wood, Brooklyn, New York.

Claim.—"The combination of the rotating roller head and the pointed mandrel."

149. For an *Improvement in Combs;* Thomas L. Calkins, Assignor to self and J. W. Bliss, Hartford, Connecticut.

Claim.—"The use of the sheath."

150. For an *Improved Piston for a Muzzle-Loading Gun;* John F. Foster and Jacob I. Banta, Jersey City, New Jersey, Assignors to selves and James H. Banta, Piermont, New York.

Claim.—"The conical packing rings on the piston. Also, the barbed fingers, in combination with the piston, to seize and draw in the ordinary cartridge."

151. For an *Improved Hand Printing Press;* Francis S. Coburn, Ipswich, Assignor to W. W. Messer, Boston, Massachusetts, and George F. Gray, Albany, N. Y.

Claim.—"The application or arrangement of the stops, and the spring, with respect to the frame and the lever, and so as to arrest the upward movement of the roller."

152. For an *Improvement in Rope Manufacture;* Michael H. Johnson, St. Louis, Mo.

Claim.—"As an improvement in the manufacture of hemp rope from the raw sliver, the combination of the condensing rollers with the callender roller and bobbin, whereby the sliver may be condensed to a greater degree than is admitted under the ordinary circumstances, governing the aforesaid manufacture with advantage."

153. For an *Improvement in Machines for Paring Apples;* Benjamin F. Joslyn, Worcester, Massachusetts.

"This invention consists in the employment or use of stationary or rotating spurs, attached to the knife rod, and placed relatively in an oblique position, and in the employment or use of a sliding mandrel, the parts being so arranged that the spurs by the rotation of the apple will feed the apple to the cutter, and cause the apple to be pared in a perfect manner."

Claim.—"The spurs, either rotating or stationary, attached or connected to the cutter rod, and placed obliquely or angularly with the apple or its axis of rotation, when said spurs are used in connexion with a sliding mandrel, for the purpose of feeding the apple to the cutter."

154. For an *Improvement in Baby Walkers;* Joseph Thomas, Assignor to self and Charles A. Durgin, Brooklyn, New York.

Claim.—"The combination and arrangement of a circular cushion, having attached thereto straps for confining the child in a vertical position, and also allowing it to turn

at will within the cushion, which is placed upon vertical adjustable legs, for the purpose of suiting the height of the child, whereby I am enabled to make a cheap and useful article of furniture, protecting the child from injury, and assisting it in walking."

155. For a *Fireman's Mask and Respirator;* Israel P. Nelson, Assignor to self, and George N. Davis, Cambridge, Mass.

Claim.—"The mask with its tubes and valves."

156. For an *Improvement in Machinery for Combing Wool;* Michael H. Simpson, Boston, Mass.: ante-dated Sept. 17, 1856.

Claim.—"The combination and arrangement of an extra doffer and stripper, (or the equivalents therefor,) with the main card cylinder, the combing doffer, and the combing belt. Also, the improved arrangement and construction of the draft rollers, with respect to each other and the combing belt. Also, making the wires of the fringe belt to extend below the table, and to run through a passage formed between the part and the combing belt, or in the belt. Also, combining with the curved plate, when such is employed in connexion with the doffer and the combing belt, a steam heating chamber, or other suitable means of heating such plate."

157. For an *Improvement in Machines for Combing Fibrous Materials;* Milton D. Whipple, Charlestown, Assignor to A. B. Ely, Boston, Mass.

Claim.—"Inclining the comb teeth to the axis of the cylinder, and covering them with the guard at the point of draft."

158. For an *Improved Screw Wrench;* Benjamin F. Joslyn, Worcester, Mass.

"This invention consists in having the shank of the lower and stationary jaw of the wrench made hollow, so as to receive the bar of the sliding jaw, and also to receive the screw which is fitted within the hollow shank, by the side of the bar of the sliding jaw, and also to receive the screw passing through a projection on the lower end of the bar of the sliding jaw, whereby a strong and durable wrench is obtained."

Claim.—"The hollow shank with the bar of the sliding jaw fitted therein, when the above parts are used in connexion with the screw placed within the hollow shank, and by the side of the bar, the screw passing through the projection on the ends of the bar."

159. For an *Improvement in Harrows;* Sidney S. Hogle, York, Ohio.

Claim.—"Causing the forward movement of a pivoted horizontal harrow, to impart a rotary motion thereto by means of the auxiliary action of a weighted roller, or its equivalent, upon one side or the other of said harrow."

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160. For an *Improvement in Cordage Machines;* James P. Arnold, Louisville, Ky.

"My invention relates to that class of cordage machines in which two or more strands are twisted in the same machine, independently of each other, and then combined by being twisted together to form a cord."

Claim.—"1st, Flattening the outer end of the nose tube. 2d, The wedge-shaped opening between the faces of the upper portion of the jaws of the nippers. 3d, Constructing the movable jaw of the rotary nippers, so that it can yield in any direction."

161. For an *Improvement in Casting Railway Car Wheels;* Norman Aylsworth, Rochester, New York.

Claim.—"The construction of the partially tubular core for the centre of railroad car wheels, the tube being formed to within a short distance of the end of said core, and communicating with the lateral passages."

162. For an *Improvement in Rotary Pumps;* Abel Barker, Honesdale, Penna.

Claim.—"Operating the two valves by means of independent attachments, which are actuated by cam grooves in the side casings of the pump, when said valves are made to work in separate chambers, in such a manner that if either valve should get out of order, the said valve and its attachments, and also the side casing on that side of the pump, may be detached from the pump, without interfering with the perfect action of the other valve."

163. For an *Improvement in Manufacturing Cotton Flannel;* Albert S. Carleton, Clinton, Massachusetts.

Claim.—"The fabric or cotton flannel having a foundation of hard thread, and an extra filling of soft yarn upon one or both sides, from which a nap is raised."

164. For an *Improved Method of Lubricating Under Pressure;* Jacob D. Custer, Norristown, Pennsylvania.

"The nature of my invention consists in forming a chambered oil cup, for oiling steam chests, steam cylinders, steam hammers, &c., by using a globe or oil chamber, and an upper and lower vertical centre stop or valve, operated by a vertical revolving cup on a vertical cylindrical stem, a vertical stuffing box, vertical screws, and two horizontal handles, all so arranged as to form unyielding seats, and permanent, tight, and durable centre valves, which will outlast the best engines."

Claim.—"The vertical revolving cup, attached to the vertical revolving cylindrical stem, the grinding or solid centre valve at the bottom, the screw and its grinding or solid centre valve, the handles, and the stuffing box, all so combined as to form a substantial vertical centre stop revolving cup, steam chest, and steam cylinder oil cup, for steam engines, steam hammers, &c., using for that purpose brass or any other metal, which may be deemed best."

165. For an *Improvement in Shirt Studs;* John P. Derby, Cavendish, Vermont.

Claim.—"1st, Widening the wire at its base for the purpose of preventing the stud from turning in the shirt. 2d, The offset in the coil for the purpose of preventing the disengagement and loss of the stud."

166. For an *Improvement in Harvesting Machines;* George Esterly, Heart Prairie, Wisconsin.

"The nature of my invention relates to the construction of the frame of a harvesting machine, with a view to its being better balanced and adjusted on its supports, and in preventing side draft."

Claim.—"Connecting the leading truck to the main frame by means of a rigid reach or secondary frame, when said reach or frame is pivoted to the rear end of the main frame, and united to the truck by a king bolt, and arranged in relation to the driving-wheel, main frame, and platform. Also, the forked lever, lifting-piece, and spring dogs, combined and operating together for lowering the sickle beam."

167. For an *Improvement in Weather Strips for Doors, Windows, &c.;* John T. Foster and Jacob J. Banta, Jersey City, New Jersey, and James H. Banta, Piermont, New York.

"The nature of our invention consists in the use of one or more strips of metal or similar substance, inserted within deep narrow grooves or mortises, on one or more sides of a door or window, and sustained by pins in diagonal slots, in such a manner that the shutting of the door or window forces out the metallic slip or bar, bringing its edge into contact with the sill or post of the door, excluding all wind, dust, &c.; and we also make use of said weather strips on the side of the door, as a locking bar, when desired."

Claim.—"Constructing weather strips with diagonal slots taking pins in the door, in such a manner that an endwise motion given to said strip in shutting the door, shall cause the weather strip to press on to the sill or casing. Also, the manner of hanging the vertical weather strip, in connexion with the upper and lower weather strip, so that the endwise motion of the latter strips shall force said strip against the vertical door post."

168. For an *Improvement in Rotary Pumps;* George W. Griswold, Carbondale, Pa.

"The nature of my invention relates more especially to the arrangement of the eccentrics within the drum or cylinder, and to the manner of operating the cut-offs in connexion with such eccentrics."

Claim.—"The double eccentrics, with their disks or plates, formed in one piece, when operating in a drum or cylinder."

169. For an *Improved Method of Operating Double Carriages in Saw-Mills;* Franklin B. Kendall, Bath, Maine.

Claim.—"Combining the devices."

170. For an *Improvement in Clamps for Brooms;* Samuel Mason, Indian Springs, Maryland.

Claim.—"So uniting the hinged portion of the case to the handle, by means of a thong, cord, or wire, as that the leverage of the handle may be used for closing said hinged portion—thus firmly closing the case on the material to hold it rigidly in the case, and to strengthen the middle portions of the clasp."

171. For an *Improvement in Rigging Vessels;* George F. Trescot, Charleston, South Carolina.

Claim.—"A separate and distinct sail and yard, which I call a storm-yard, and sail on the lower mast, so that in event of a ship losing her top-masts, or head of lower masts, would still have her storm sails to work off a lee shore, and by the division of the shrouds, the masts are better secured, though longer, and no more weight aloft than usual."

172. For an *Improvement in Machines for Breaking Slabs or Blocks of Stone into Regular Forms;* Ira Merrill, Shelbourne Falls, Massachusetts.

Claim.—"Breaking stone into regular forms by pressure and percussion, when both are applied at the same time to the slab or block of stone to be broken."

173. For an *Improved Apparatus for Making Nitric Acid;* Philip O'Reilly, Providence, Rhode Island.

Claim.—"Purifying nitric acid, in the manufacture from chlorine and nitrous fumes."

174. For an *Improvement in Pocket Lanterns;* Andrew Ralston, West Middletown, Pennsylvania.

Claim.—"The sliding cap, the cap, and the wick tube, with its two rings or disks."

175. For an *Improved Water-Wheel;* Samuel Reynolds, Oswego, New York.

Claim.—"The radial floats above the horizontal plane, in combination with the buckets or floats below said plane, constructed narrowed where they join the radial floats, gradually increasing in width outwardly, in depth downwards, with an inclination towards the centre to their termination, making the outlet to discharge the water deeper towards the centre than towards the periphery."

176. For an *Improvement in Processes for Preparing Fertilizers;* Lawrence Reid, Barren Island, New York.

"The nature of my invention consists in making a combination of animal and earthy matters with saline ingredients, in such proportion and prepared in such manner as will form a compound of salts of ammonia, super-sulphate of lime, sulphate, dried clay, and animal matters (all established fertilizers), producing this result by the treatment of animal or fish offal, with sulphuric acid, water, bones, and clay."

Claim.—"Treating with acid only the liquid parts of the animal matter, after the same has been boiled or treated by high pressure steam, and then treating the same with bone dust and absorbents."

177. For an *Improved Portable Cross-cut Sawing Machine;* Stephen Scotton, Richmond, Indiana.

"The nature of my invention consists in placing a reciprocating saw upon a locomotive frame work—the engine being placed at right angles with the line of motion of the carriage—the saw slides being borne in adjustable guides, which allow it to be used in a horizontal movement in felling trees, and in a perpendicular for logging off together with two circular saws in swinging frames—the one swinging horizontally, the other perpendicularly."

Claim.—"1st, The combination of the saw in swinging frames, in combination with the locomotive carriage. 2d, The combination of saw and frame with the swinging saw table and sliding bar. 3d, Saw in horizontal swinging frame, in combination with the locomotive carriage."

178. For an *Improvement in Steam Brakes for Railroad Cars;* Theophilus E. Sickels, Kennett Square, Pennsylvania.

Claim.—"The so combining the use of steam, or its equivalent, with the brakes of railroad cars, as that the steam shall hold the brakes from the wheels, and its partial use or disuse admit a weight or spring to apply said brakes."

179. For an *Improvement in Operating Ships' Windlass;* Norman Smith, Stonington, Connecticut.

Claim.—"Operating the windlass for raising anchors, and for other purposes, on ship

board, by means of a crank or eccentric on the axis of a capstan, or other upright shaft, through the medium of pawls attached to levers, and working in ratchets on the windlass beam."

180. For an *Improved Grappling and Dredging Machine;* Augustus Stoner, Mount Joy, Pennsylvania.

Claim.—"The combination of the machine, the supporting and lever-shifting cross-piece, the mitred shovels, the ring, or its equivalent, to sustain the apparatus and chains, so linked and constructed to operate all the levers simultaneously, and sustaining the cross-piece aforesaid."

181. For an *Improvement in Mangles;* Richard A. Stratton, Philadelphia, Penna.

Claim.—"The rollers, in combination with the movable roller, arranged and driven for the purpose of acting upon the roller, in such a manner that the cloth on the same may be efficiently mangled without winding it from one roller to another, and for the purpose of removing and replacing the said roller with facility."

182. For *Improved Saw-Mill Dogs;* John A. Taplin, Fishkill, New York.

Claim.—"The double arm rocking dogs, constructed, arranged, and operating in connexion with the wedges, in combination with the traversing carriage."

183. For an *Improved Carpenters' Plane;* M. B. Tidey, Ithaca, New York.

Claim.—"The application to the cavity of the plane stock of a metallic bit-case, and so applying it, that its lower extremity shall constitute a part of the plane's face."

184. For an *Improved Mode of Attaching Hubs to Axles;* James M. White, Xenia, Ohio.

Claim.—"The combination of the parts marked."

185. For an *Improvement in Locks;* William Whiting, Roxbury, and Henry Pickford, Boston, Massachusetts.

Claim.—"Holding the slides in the exact position to which they are raised by the tumblers, by the pressure of an elastic cushion, or its equivalent."

186. For an *Improved Mode of Regulating Velocity, and Furling the Sails of Wind-Wheels;* Frederick W. Witting, Twelve Mile Coletto Gin, Texas.

"The nature of my invention consists in the peculiar arrangement of parts, or the means employed for regulating the sails, whereby they may, by the action of the wind, be turned more or less obliquely with it, and cause the wheel to rotate with equal speed, however much the wind may vary in velocity. Also, in the peculiar means employed for folding and unfolding the sails."

Claim.—"Connecting the spindles to the sliding-rod, by means of the part pinions or segments, and a rack. Also, furling and unfurling the sails by means of the drums attached to the rod, and the cords attached to the drums and sails."

187. For an *Improved Circular Sawing Machine;* George F. Woolston, Washington, District of Columbia.

Claim.—"1st, The application and use of guard plates, in combination with knives or cutters formed in saws, or inserted therein. 2d, The manner of applying the said plates, holding them firmly, and so adjusting them as to prevent vibration of the saw."

188. For an *Improved Method of Regulating Velocity of Wind-Wheels;* A. W. Wood, Milwaukie, Wisconsin.

Claim.—"Enclosing the wind within a cylindrical case formed of two rows or series of vertical slats, one row or series of which is placed in a reverse position to the other, and encompassing said case with a gate, which may be raised and lowered on said case in any proper manner, the above parts being constructed and arranged for the purpose of regulating the speed of the wind-wheel."

189. For an *Improvement in Smut Machines;* William Zimmerman, Quincy, Ill.

"The nature of my invention consists in a series of stationary and revolving cylinders, arranged on disks from their centre outwards, roughened on both sides, so as to scour and clean the grain as it passes between them successively."

Claim.—"A series of stationary and revolving cylinders, arranged on disks, or their equivalents, from the centre outwards."

190. For an *Improvement in Railroads;* Hiram Carpenter, City of New York, Assignor to the American Iron Railway Company.

"The nature of my invention relates to the chair and its support, the object being to make an iron superstructure, cheap, durable, and with the requisite spring or yield to the rolling stock, without the use of bolts, keys, &c."

Claim.—"In combination with the tie and pedestal cast in one piece, the chairs, so constructed as to fit in or on said pedestals, and to hold the rails without the use of bolts, spikes, or keys."

191. For an *Improvement in Feeding Drill Shaft;* George C. Taft, Assignor to Henry W. Mason, Worcester, Massachusetts.

Claim.—"Combining the pawl with the vibrator lever, by a secondary lever and spring applied to them."

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192. For an *Improvement in Ploughs;* Elliot Andrus, Geneva, New York.

Claim.—"The frame for the purpose of holding the mould board, attaching the handle, and supporting the end of the wheel-shaft. Also, the manner of attaching the mould board upon pivot points, in combination with the lock and links. Also, the combination of the wheel cams and friction roller, or their equivalents, to produce the oscillating motion of the mould board."

193. For an *Improvement in Grade Delineators;* George R. Clark and Samuel Adams, Antioch, California.

Claim.—"1st, The use of a pendulum, or its equivalent, operated upon by gravitation, in combination with the cones and the friction wheels, or their equivalent. 2d, In combination with the pendulum and the cones, the arrangement of the arms, the bars, and the slides, to move the friction rollers along the cones. 3d, Combining the pendulum, or its equivalent, with the paper rolls and grade pen, or either of them, in such a manner that their respective motions may produce correct horizontal and vertical scales, or a profile of the ground traveled over by the carriage."

194. For an *Improvement in Manufacturing Yarns from mixed Cotton and Wool;* George S. Bradford, Sandlake, New York.

Claim.—"Carding through the finisher, the drawing made by covering an evenly prepared cotton drawing with wool, thereby leaving most of the wool on the outside of the finished roving card, without carding the cotton through any wool carding machine but the finisher, and hence leaving the staple of the cotton straight in the finished roving."

195. For *Portable Boats;* Robert C. Buchanan, Baltimore, Maryland.

Claim.—"The portable boat, the same consisting of the portable skeleton frame work, and unprepared canvass, secured to the frame work by lashings."

196. For an *Improvement in Steam Drying Cylinders;* John Booth, Pawtucket, R. I.

Claim.—"The arrangement of the steam and water pipes at one end of a drying cylinder."

197. For an *Improvement in Corn Cultivators;* John B. Baker, Onondaga, N. Y.

"The nature of my invention consists in constructing the forward adjusting bar, with circular brace in front or arc, which serves the double purpose of brace to said bar, and of fender to push the stalks aside without breaking them."

Claim.—"The arc or fender, in combination with the adjusting bar, whereby the stalks are laid aside, and the said bar rendered much more durable."

198. For an *Improvement in Gang Ploughs;* Jesse Frye, Springfield, Illinois.

"My invention relates to a gang or series of ploughs, so combined with a set of supporting and guiding wheels and a frame, as that the conductor mounted on the plough can adjust the width of the furrow slices, the depth and direction of the furrows, direct the turning of the plough at the end of the land, and all other things necessary to the perfect guidance and operation of the plough in question."

Claim.—"The so hanging of a gang or series of ploughs upon their stock and beam, as that the conductor upon his seat may, by a system of hand levers and connecting rods, adjust said series of ploughs to any desired depth or width of furrow."

199. For an *Improvement in Brick Machines;* James A. Dorr, Ira Hersey, and Edward G. Oldfield, City of New York.

Claim.—"The combination of the cams, eccentrics, and slotted projection, attached to a strap, with the rollers, beam, and lower pistons."

200. For an *Improved Lock;* V. R. David, Newark, Illinois.

"My invention consists in the employment or use of a stop, applied to the lock and arranged and operated in a peculiar manner, whereby the bolt is prevented from being moved till the stop is moved free from it, and the lock thereby rendered extremely difficult to pick."

Claim.—"The bar, with projection attached, in combination with the slide fitted within the slotted chamber, the above parts being arranged and used in connexion with the bolt."

201. For an *Improvement in Sleeve Buttons;* John P. Derby, Boston, Mass.

Claim.—"The lever, which is used by increasing the distance between the joint and the face plate by the means of a post, so shaped that the arm can be raised and depressed, said arrangement allowing the fastener to be entirely operated from the face sides, in securing it to, and detaching it from, the wrist bands."

202. For an *Improved Bullet Mould;* Henry L. De Zeng, Geneva, New York.

Claim.—"The movable cam-jaw, in combination with the cutting bar, whereby the movable jaw is held to the stationary jaw while the bullet is being cast, by forcing the handles apart, and on pressing the handles together the projection from the bullet is first cut off, and then the movable jaw is thrown back to discharge the bullet."

203. For an *Improved Rotary Shingle Machine;* Edwin Edwards, Oneida Lake, N.Y.

"This invention relates to an improvement in that class of machines for cutting shingles, in which cutters are attached to, or secured in, a rotating wheel."

Claim.—"The employment or use of the adjustable annular gauges, formed each of two parts and applied to the wheel."

204. For an *Improvement in Sewing Machines;* James E. A. Gibbs, Mill Point, Va.

Claim.—"Making a series of lock stitches with a double hook reciprocating the motion of a single revolution or part of such revolution. Also, in combination with a sewing machine, the hollow thread case of a spherical oval, or any other similar form, for containing a ball of thread having no fixed axis of revolution. Also, attaching to the globular thread case a plate, or its equivalent, furnished with two hooks, which are placed symmetrically, and combining the whole with any suitable mechanism that will impart thereto a reciprocating motion of a single revolution or part of such revolution, when the axis of revolution is fixed."

205. For an *Improved Machine for Creasing Plates for Railway Car Springs;* Perry G. Gardiner, City of New York.

Claim.—"The use of the V shaped roller and flat faced roller for creasing its plates, when operating in connexion with the carriage, the plate, and guide or stop plate."

206. For an *Improved Machine for Disengaging Railway Car Springs from Mandrels;* Perry G. Gardiner, City of New York.

Claim.—"The peculiar construction of the disengaging tool, and the manner of constructing the platform, when operating in connexion with spindle for detaching the coil."

207. For an *Improved Machine for Manufacturing Shoe Lasts;* Alanson and Wm. P. Haskell, North Brookfield, Massachusetts.

Claim.—"1st, The use of the concave head in connexion with the adjustable guides and rest. 2d, So constructing and hanging the bent lever, or its equivalent, as to allow the same pattern to be used for the different sizes, the position of the pattern governing the size. 3d, The combination of the lever, plate, and cutter head."

208. For an *Improved Composition for Floor Cloths;* J. W. Harman, Brooklyn, N.Y.

Claim.—"The use of this compound, or the application of the same, to the making and manufacturing of floor cloth carpets."

209. For an *Improved Steam Carriage;* John S. Hall, Pittsburgh, Pennsylvania.

Claim.—"1st, So combining and arranging the driving machinery and body of the carriage, with the wheels and axles, that the latter may be both swiveled, moved, or adjusted in any and all directions, without in the least changing the relation of the

parts, or otherwise affecting the said driving machinery or body of the carriage. 2d, The stationary universal driving bearings or boxes, or their equivalents, whereby the axles and wheels may be readily rotated or driven in all their variable relative positions, with the driving machinery and body of the carriage. 3d, The double ratchet wheel, in combination with the pawls and spiral spring."

210. For an *Improved Hinge;* R. Hart, Marietta, Ohio.

"The nature of my invention consists in the employment of movable arms or levers, attached to one portion of the hinge or apparatus, and arranged to operate on flat and inclined planes or surfaces on the other portion of the hinge or apparatus, and thereby cause the gate or door to open and close."

Claim.—"The employment of the arms or levers. Also, in combination with the movable arms or lever, the lever constructed and arranged with a shifting pawl."

211. For an *Improvement in Corn Harvesters;* Abram Heulings, Philadelphia, Pa.

Claim.—"The combination of the tilting platform, the gates, curved arms, and swinging links, with the rock shaft, and its operating lever and rod, when said parts are arranged for joint operation."

212. For an *Improvement in Dry Gas Metres;* Hyam Jacob Hyams, Russia; patented in England, Feb. 16, 1856.

"My invention relates to that description of gas metres commonly called dry gas metres, and in which one side of the measuring compartments is formed by means of a movable or flexible diaphragm."

Claim.—"The connecting together the rigid parts of the movable diaphragms, in order that they may act together. Also, the construction and arrangement of the rotating circular valve."

213. For an *Improved Machine for Cutting Slots in Clothes Pins;* John Humphrey, Keene, New Hampshire.

Claim.—"A holder, so constructed that the pins may be received into a groove or chamber behind the part in which they are secured for the action of the saw, and then driven forward by a driving rod, or its equivalent, to the proper position for the cutting of the slots, the same being stationary or having a reciprocating motion. Also, in combination with the holder, the saw, the inclined spout, and the dog, or their equivalents."

214. For an *Improvement in Machines for Husking Corn;* Abraham R. Hurst, New Cumberland, Pennsylvania.

Claim.—"The employment or use of the sliding jaws or plates, lever, and plate or disk, the jaws or plates placed or fitted on the bed piece or platform, the above parts being arranged and used in connexion with the knife or cutter."

215. For an *Improvement in Carriage Tops;* R. S. Jennings, Waterbury, Conn.

Claim.—"The employment of a transverse hinge joint on each of the bows, at the centre of their top or horizontal portion, in combination with staples and two pair of bars, which are pivoted at one end to the front bows, and at the other end are each provided with a slot, and furnished with a hook."

216. For an *Improvement in Bee Hives;* Albert Kelsey, Westport, Missouri.

Claim.—"In combination with the double chambers of sash frames, the two walls with communicating passages through them, when said walls or partitions are so arranged that a slide or cut-off can be introduced between them, for the purpose of an entire separation."

217. For an *Improvement in Machines for Making Paste-board;* Louis Koch, City of New York.

Claim.—"1st, The arrangement of the roller, in connexion with the arm and projection or screw, for the purpose of operating the lever by which the slide is held fast or set at liberty when the board has obtained the required thickness, together with the arrangement of regulating by means of said screw, the required thickness of the paste-board. 2d, The movable slide, or its equivalent, constructed and operated for the purpose of cutting or tearing and lifting the paste-board, which was formed on the roller, from said roller, after the same has obtained the required thickness. 3d, The arrangement of the movable frame, with leather, or its equivalent, attached, for the purpose of stripping off the cut paste-board from the end of the slide."

218. For an *Improvement in Prairie Ploughs;* Jesse Frye, Springfield, Illinois.

Claim.—"1st, Supporting the after end of the plough beam upon a vertical journal,

at the left hand end of the axle, when the bearings at the opposite end of said axle are so arranged that the position thereof may be varied and adjusted. 2d, Arranging the bearings of the rollers in such a manner that their positions may be varied and adjusted. 3d, In combination with the mould board composed principally of the series of adjustable rollers. Also, the adjustable triangular plate, for the purpose of making the whole conform to the position in which the furrow slice is to be laid or turned."

219. For an *Improvement in Machinery for Pressing Water out of Paste-board;* Louis Koch, City of New York.

Claim.—"The combination of the pressing-rollers, in connexion with the roller, arranged with endless felts in such a manner that the board shall be made to pass between the pressing rollers, between two thicknesses of felting to allow the water contained in the board to be pressed out of the same without injuring the board, during the pressing process."

220. For an *Improvement in Seed Planters;* George A. Meacham, City of New York.

Claim.—"1st, The box provided with the elastic side, and the head, or its equivalent, for the purpose of distributing or measuring the seed. 2d, The 'planter,' attached to the foot of the operator, and formed of the boards connected by the elastic straps, the boards having the plates attached to them and the under side of the board, the plate attached, the whole being arranged for the purpose of planting or forcing the seed into the soil by the pressure of the foot."

221. For an *Improvement in Preparing Yarn for Dyeing and Scouring;* Lucian E. Pratt, South Kingston, Rhode Island.

Claim.—"Making muffs of thread or yarn, to be dyed, or otherwise treated; the said improvement consisting in winding a series of threads, each separated from or at a distance from the other, in one helix band around a cylinder or drum, and so that the coils of each layer of such on the cylinder may cross those of the next layer."

222. For an *Improvement in Corn Planters;* John Miller, Bucyrus, Ohio.

Claim.—"The auxiliary compartment, having a slide acting simultaneously with the seed slide, for the purpose of designating the point of planting."

223. For an *Improved Mode of Securing Bits in their Stocks;* A. C. Moore, Wilmington, Vermont.

Claim.—"The application to bit stocks of a plain socket with a screw cap to hold the bit in place by a pressure upon the shoulder of the bit-head, thereby doing away with the necessity of fitting a bit before use, and gaining the advantage of a sure and firm fastening."

224. For an *Improved Method of Centering and holding Hubs while being Bored;* A. Moore, Honeyoye Falls, New York.

Claim.—"1st, The construction of the chuck, consisting of the combination of the ring and arms, said arms moving upon the fixed and movable points. 2d, The arrangement of the frames."

225. For an *Improvement in Harrows;* John E. Morgan, Deerfield, New York.

Claim.—"The providing for the vertical action between the two parts of the harrow, by means of the coupling formed by the use of the vertical elongated links, operating on the rod, or its equivalent."

226. For an *Improved Enema Syringe;* Charles H. Davidson, Charlestown, and Herman E. Davidson, Gloucester, Mass., Assignors to Charles H. Davidson, aforesaid.

Claim.—"The combination of the prolate of the spheroidal shaped elastic sack, with flexible tubes terminating in valve boxes containing valves, arranged for the purpose of eduction and ejection, when the sack tubes and valve boxes are in, or nearly in, the same axial line."

227. For an *Improvement in Steamboat Capstans;* John Schaffer, Manchester, Pa.

Claim.—"A capstan, the shaft of which rotates within the drums, which can be rotated separately or in conjunction with, and by or independently of, said shaft."

228. For an *Improved Automatic Lathe for Turning Irregular Forms;* William D. Sloan, City of New York.

Claim.—"The series of rotating and shifting mandrels for rotating the blocks to be turned, and shifting them from one operation to another, in combination with the series

of traversing cutters, girded by patterns or moulds to determine the form to be produced, whereby a series of blocks are simultaneously subjected to the series of operations, and each in succession subjected to all the operations. Also, the mode of operation of the cutter, termed the finishing cutter, which said mode of operation consists in rolling the cutting edge along the surface of the block that is being turned, by reason of which a small portion only of the cutting edge is cutting at any one time, and immediately relieved and followed by another portion of the said cutting edge. Also, the sliding segment ring with its slots, in combination with the cutters and their appendages, for carrying the rangling cutters nearer to the axis of the blocks at each successive cutting action."

229. For an *Improvement in Steam Ploughs;* David B. Spencer, Parkersburg, Va.

Claim.—"The use of the single wheel at the rear end of the carriage as the sole driving wheel, and running in the bottom of the furrow turned by the plough. Also, hanging the two supporting wheels eccentrically on the same turning or rocking axle, so that whether the machine runs upon the level ground, or with one wheel higher or lower than the other, the frame and boiler shall still preserve its horizontal position."

230. For an *Improved Method of Constructing Bit Stocks;* Abel W. Streeter, Shelbourne Falls, Massachusetts.

"The nature of my invention consists in providing a bit stock with joints, for the purpose of folding in smaller compass for the convenience of packing in the mechanics' pocket or chest."

Claim.—"The construction of a bit stock in sections, said sections being connected by joints. Also, the mode of attaching the stock cap to the stock, by means of the box or tube, and cross pin, or its equivalent."

231. For an *Improvement in Stoves for Railway Cars;* George W. Thompson, Bordentown, New Jersey.

Claim.—"The balanced valve as hinged to the interior of the pipe, in combination with the lever, levers, their disks, and the perforations in the cap."

232. For an *Improvement in Shaping Engines;* Sylvanus J. Wetherell and Eustace P. Morgan, Biddeford, Maine.

Claim.—"To make the screw a stationary male screw, and the female screw (attached to the carriage, and made to work on the screw,) a rotary, and to combine with them and the gear (by which and the gear the shaft is rotated), the gears (the latter being made to rotate on the shaft, and to be fixed to the former as occasion may require, by a pin, or its equivalent), a rocker arm, and double pawl, (or mechanical equivalents therefor,) applied to the shaft, the whole being to enable a workman to control the operations of the machine as stated, without being obliged to go to the end of the frame, or leave his work, in order to adjust or change the feed motion of the cutting tool, whether it be planing either plain or cylindrical work."

233. For an *Improved Raking Apparatus for Harvesters;* Jesse Urmy, Wilmington, Delaware.

Claim.—"Operating the rear end of the rake by means of a crank, when said crank moves with the pin that operates the rake bar, in combination with the connecting rod and adjusting holes."

234. For an *Improvement in Baby Jumpers;* Marion J. Wellman, City of New York.

Claim.—"The combination of the cross and corner springs, attached to separate points of suspension, at a distance from the centre and beyond the centre of gravity, with an infant's seat."

235. For an *Improved Method of Feathering the Sails or Vanes of Wind-Mills;* J. C. and F. G. Wilson, Cedar Hill, Texas.

"The nature of our invention consists in giving the wings a means of bringing the edges of the wings to the wind, for the protection of the wheel during storms."

Claim.—"The combination of the traversing screw, having stops with the slide piece and rods leading to the wing."

236. For an *Improved Gunpowder Keg;* James Wilson, Charles Green, and Wm. Wilson, Brandywine, Delaware.

Claim.—"The making the sides or cylinder of corrugations, and bulge or swell, when employed with the extra ring and boss-head, for the purpose of greater strength, and more convenient handling."

237. For an *Improved Fluid Metre;* James Cochrane, City of New York.

Claim.—"In combination with a tilting measuring vessel, or its equivalent, enclosed within an air-tight vessel, a secondary air-tight vessel connected with the former. Also, combining with a measuring vessel, treated in, and combined with, an air chamber, an apparatus which shall from time to time introduce portions of the outer air into the interior of the air chamber."

238. For an *Improvement in Life Preserving Bedsteads and Sofas;* John T. Garlick, City of New York.

Claim.—"The air and water-tight bedstead, settee, or sofa."

239. For an *Improved Machine for Composing and Distributing Type;* William H. Houston, Belfast, Maine.

Claim.—"1st, The machine for composing types. 2d, The method of selecting the types from the cases, by means of the springs, or their equivalents, operating in connexion with the keys. 3d, The method of transferring the types to the stick by means of the plungers, or their substantial equivalents. 4th, Raising the rule, and throwing forward the line of type upon the galley, by any means substantially the equivalent thereof. 5th, The method of feeding forward the types in the cases by means of the slipping bands, rods, and cylinder, or their equivalents. 6th, The wheel, with its ratchet wheel, and the connexions, or their equivalents, whereby this wheel is caused to give motion to the shaft whenever any one of the keys is depressed. 7th, The method of connecting the crank with the pitman, by means of the spring. 8th, The distributing machine, constructed by means of which a column of type, when placed in the machine, is distributed automatically. 9th, The method of forwarding the types to the trial case, by means of the vibrating case."

240. For an *Improved Machine for Washing Gold;* Samuel S. Lewis, San Juan, Cal.

"The nature of the invention consists in constructing the riffle boxes with bars, forming an upper surface, over which the large debris or rock shall be carried by the stream of water employed, while the finer portions of soft ground on the bars, by attrition thereof with the magnetic sand and precious metal, shall be subjected to a sub or under current of water, while passing between the ribs of the aforesaid ribs."

Claim.—"Employment of riffles or bottoms, constructed so that an under current of water may be used between the ribs, in connexion with that flowing over the surface of the bars of the riffles."

241. For an *Improvement in the Manufacture of Paper Pulp;* Columbus F. Sturgis, Carlowville, Alabama.

Claim.—"The process of manufacturing paper pulp from the bark of the root and the bark of the stalk of the cotton plant."

242. For an *Improvement in the Manufacture of Paint Brushes;* James T. Steer, City of New York.

Claim.—"The use of the binding ferrule for the purpose of effecting the introduction of the bristles into the cap ferrule, the said cap ferrule being made in one piece with its cap and shank."

243. For an *Improved Gas Regulator;* Charles J. Halstead and John Cœyman, Assignors to Decker, Godine & Halstead, City of New York.

"The nature of our invention consists in attaching to the main or service pipe leading to the metre, our improved regulator, so combined as to preclude the possibility of an unavoidable waste of gas."

Claim.—"A gas regulator, to be located between the metre and main gas pipe, and composed of the perforated plate, having a flanch upon it provided with external and internal screw threads, and a plate similarly perforated and provided with a screw which runs into said internal screw thread on the plate, and adjustable therein by its stem, when said plates are combined with a single valve and adjustable spring, and the whole arranged within the shell."

244. For an *Improved Machine for Printing from Engraved Plates;* Linus Stewart and John McClelland, Assignors to David and J. McClelland, Washington, D. C.

Claim.—"Heating the plate from which the impression is to be taken, by means of a hollow bed plate into which steam is admitted. Also, the cleaning of the plate by means of a horizontally revolving cleaning apparatus, in which a clean surface is constantly brought into contact with the plate at every revolution of the cleaner. Also, in

combination with the fingers or nippers, the cam and spring, which alike hold them, whether opened or closed."

245. For an *Improved Form or Mould on which Wooden Slats, &c., are made into Baskets;* J. A. H. Ellis, Assignor to J. Woodbury, Trustee, &c., Springfield, Vt.

Claim.—"The basket mould, constructed of a block or former made with annular and top recesses, and provided with a shoulder ring, hoop catches, and the bottom clamping plate and screws, or equivalents therefor."

246. For an *Improved Machine for Cutting the Throats of Carpenters' Plane Stocks;* Henry S. Dewey, Assignor to self and Levi W. Newton, Bethel, Vermont.

Claim.—"The combination of the shaft path cutter, the plane iron and wedge throat cutter, the movable carriage, and the adjustable bearer, by which the inclinations of the ends of the throats may be obtained."

247. For an *Improvement in Making Table Knives;* Conrad Poppenhusen and C. F. E. Simou, Assignors to Conrad Poppenhusen, College Point, New York.

Claim.—"The mode of procedure by which we effect the union of the steel blade with the cast balanced nut, whether of malleable or ordinary cast iron, by preparing the rear end of the steel blades with cleansed parallel sides, fitting a groove with parallel sides in the cast balance nut, preparing the surfaces with borax, or other equivalent flux, and then welding the same by heat and pressure."

Additional Improvement.

1. For an *Improvement in Fire Arms;* Frederick D. Newbury, Assignor to Richard Varick De Witt, Jr., Albany, New York; patented August 12, 1856; additional dated March 31, 1857.

Claim.—"The employment of a permanent cone, combined with a ring lying between it and the chamber of the barrel, with a disk fitted upon the ring—the ring being divided on one of its sides by a cut, into which is fitted a pin or wedge—the cone or wedge being so shaped in reference to the ring, as to expand it against the charge chamber upon the least re-action of the charge when fired."

Re-Issues for March, 1857.

1. For an *Improvement in Breech Loading Fire Arms;* B. F. Joslyn, Worcester, Mass.; patented Aug. 28, 1855; re-issued March 13, 1857.

Claim.—"A cone headed pin, with two or more expanding rings—and in making the exterior of a breech pin cone-shaped—also, combining the same with the radial or hinge breech."

2. For an *Improvement in Carding Engines;* A. D. Shattuck, Grafton, Massachusetts; patented Sept. 23, 1856; re-issued March 10, 1857.

Claim.—"1st, The application to carding engines of two or more variable cylinders, arranged and operated for the purpose of preventing the filling up of the main cylinder. 2d, The use of a doffer, in combination with strippers or cleaners, arranged and operating for the purpose of preventing the filling up of the main cylinder, and producing an uniform sheet."

3. For an *Improvement in Saw-Mills;* Wm. P. Wood and Samuel De Vaughan, Washington, D. C., Assignees of George W. Hedge, Brooklyn, N. Y., Assignee of Lemuel Hedge, City of New York; patented May 8, 1849; re-issued March 10, 1857.

Claim.—"The means to regulate the deflection of the saw blade when at work—that is to say, the application of the feed rollers to the back of the saw blade. Also, the driving power to the lower pulley, when the saw is designed to work in its downward motion."

4. For an *Improvement in Looms for Weaving Pile Fabrics;* Erastus B. Bigelow, Boston, Mass.; patented Dec. 18, 1855; re-issued March 17, 1857.

Claim.—"Successively drawing the pile wires from the cloth by a latch or hook. Also, constructing and operating said latch hook, so that after drawing said pile wires from the cloth, it successively delivers them to a carrier, or other apparatus, which completes their movement. Also, in combination with a latch or hook for drawing the pile wires from the cloth, a carrier or apparatus, to successively receive said pile wires from said latch or hook, and transfer them to the fell of the cloth. Also, the method of inserting the pile wires into the upper shed of the warps, while the shuttle is pressed through the lower shed."

5. For an *Improvement in Running Gear of Carriages;* Gustavus L. Hausknecht, New Haven, Connecticut; patented January 13, 1852; re-issued March 17, 1857.

Claim.—"1st, The combination and arrangement of the pivot in the rear of the fore axle, and the segments, with the perch and head block, or perch cross-bar of carriages having perches, or the equivalents thereto, for the purpose of enabling carriages to turn in a shorter space than by the common mode of coupling with perfect safety. 2d, The additional set of segments, or their equivalents, the pivot placed perpendicularly above the lower turning point, to be employed where the springs are fastened to an axle, and move with the same."

6. For an *Improvement in the Machine for Sawing off Logs;* Cornelia Waterman, Brooklyn, New York, Administratrix of Stephen Waterman, deceased, Greenwich, Connecticut, Assignee of Isaac D. Russell, City of New York; patented May 19, 1843; re-issued March 17, 1857.

Claim.—"Revolving a log or block while being sawed, in order that the pieces sawed off may be of uniform thickness on all sides, and the mechanism, or its equivalent, for raising and lowering said block, that it may be sawed into pieces of any desired thickness, without being removed from the machine, said block being centered but once in sawing up the entire log."

7. For an *Improvement in Sugar Works;* Norbert Rillieux, City of New York; patented Aug. 26, 1843; re-issue dated March 17, 1857.

Claim.—"1st, The employment of a vacuum pan or pans, in combination with an evaporating pan or pans, or boiler, in which the saccharine juice or other fluid is evaporated under a pressure lower, equal to, or greater than, the atmosphere, which last mentioned pan or pans, or boiler, prepares the saccharine juice, &c., from the vacuum pan or pans, and at the same time supplies the necessary vapor from the saccharine juice, &c., to complete the evaporation or concentration of syrup, &c., in the vacuum pan or pans. 2d, The employment of a weighted throttle or other regulating valve, in the main steam pipe."

8. For an *Improvement in the Machine for Forming the Web for Cloth of Wool, Hair, or other suitable substances, without Spinning or Weaving;* The Union Manufacturing Company, Assignees of John Arnold and George G. Bishop, Norwalk, Connecticut; patented October 20, 1836; extended by Commissioner from October 20, 1850; extended by Act of Congress, March 28, 1854; re-issued March 17, 1857.

Claim.—"The mode of operation by means of which the slivers of the weft fibres are kept properly distended, until their entire surface is in contact with the surface of the sliver of warp fibres."

9. For an *Improvement in Harrows;* Sidney S. Hogle, York, Ohio.

Claim.—"Causing the forward movement of a pivoted horizontal harrow to impart a rotary motion thereto, by means of the auxiliary action of a weighted roller, or its equivalent, upon one side or the other of said harrow."

10. For an *Improvement in Vault Covers;* John B. Cornell, City of New York; patented Feb. 19, 1856; re-issued March 24, 1857.

Claim.—"Grooving or channeling the upper surfaces of the metallic portions of illuminating covers; but this I only claim when the glasses in said grooved covers are so arranged as to bring their upper surfaces flush with, or a little above, the upper surfaces of said covers."

11. For an *Improvement in Setting Mineral Teeth;* John Allen, City of New York; patented Dec. 23, 1851; re-issued March 24, 1857.

Claim.—"A new and useful mode and improvement in setting mineral teeth on metallic plates, by means of a fusible mineral compound or cement, which is used to fill up the interstices between and around the base of the teeth and upon the plate, of which a continuous artificial gum is formed without seam or crevice."

12. For an *Improvement in Window Curtain Fixtures;* Silas S. Putnam, Boston, Mass.; patented April 15, 1851; re-issued March 31, 1857.

Claim.—"Attaching the curtain to its roll by a piece or strip, which fits into a groove in the roll, and is secured thereto by caps at the ends."

13. For an *Improvement in Planing Machines;* James A. Woodbury, Winchester, Mass.; patented July 7, 1854; re-issued March 31, 1857.

Claim.—"1st, The combination of the rotary disk cutter with the pressers and bed. 2d, The combination of the Bramah wheel, so called, with the rotary disk cutter and

its accessories, for the purpose of planing. 3d, The method of planing with a continuous drawing cut."

14. For an *Improvement in Platform Scales;* Thaddeus Fairbanks, St. Johnsbury, Vermont; patented January 13, 1857; re-issued March 31, 1857.

Claim.—"My improved arrangement and combination of four bearing multiplying levers, a multiplying lever, and a lever, made so as to act at the same time as an equalizing and a multiplying lever—the whole being applied to a steelyard weighing lever. Also, arranging the suspension bridge so that its arched standards shall extend upwards by the sides of the platform, and between it and the sides of the pit, in combination with arranging the transverse levers and their bearings below the platform—the same affording the necessary room for the vertical play of the longitudinal levers, while it secures an advantage as regards the depth of the pit."

15. For an *Improvement in Furnace for Burning Wet Fuel;* Moses Thompson, City of New York; patented April 10, 1855; re-issued March 31, 1857.

Claim.—"Using green bagasse, wet tan, wet saw dust, and other wet carbonaceous or vegetable substances, as fuel for the production of intense heat, by mingling the gases issuing from a highly heated mass thereof, with those arising from carbonaceous combination, by the intervention of a flue or chamber, with which the chamber or chambers containing the fire and charge of wet substances communicate, and in which said gases meet, mingle, and consume each other on their way to the apparatus to be heated, and to the stack. Also, the combination, for the purposes of a high degree of heat, of bagasse, refuse tan, saw-dust, and other wet refuse substances, or very wet and green wood, by the employment of a series of fire chambers, arranged in any manner to communicate with one common flue or mixing chamber, when any number of said chambers are nearly closed to the admission of air when first charged, whilst the remaining chamber or chambers is in full communication with the mixing chamber, and has a proper supply of air admitted, and the ash-pit of each chamber in its turn is nearly closed, and then opened, and has air admitted, whereby the heat required is rendered continuous, and comparatively uniform, while the fuel in some of the chambers is being heated and decomposed, and its gases sent forward to the mixing chamber to any desirable degree."

Designs for March, 1857.

1. For *Cooking Stoves;* Allen Comstock, Quincy, Illinois; dated March 10, 1857.

Claim.—"The design and configuration of the several parts of the stove, in combination with the projecting pilasters, mouldings, and ornaments in relief."

2. For *Stove Doors;* M. C. Burleigh, Great Falls, N. H.; dated March 10, 1857.

Claim.—"The central ornament within the annular bead, the angular corrugations on the face or panel of the door, and the beads around the edges of the panel, and the beveled or inclined edges of the door, having the ovolo beads upon them and the obtuse quirks."

3. For *Floor Oil Cloths;* James Hutchison, Assignor to Jonathan E. Whipple and Stephen E. Haskell, Lansingburgh, New York; dated March 10, 1857.

Claim.—"The arrangement of ornamental figures."

4. For *Soda Water Apparatus;* Jos. Bernhard, Assignor to self, Joseph Hindermeyer, and Louis Gansz, Philadelphia, Penna.

Claim.—"The design and configuration of the parts of the self-cooling draft apparatus."

5. For *Radiator Stoves;* N. S. Vedder, Troy, N. Y., Assignor to Galbraith & Cassell, Jacksonville, Illinois.

Claim—"The ornamental design and configuration of the end plate and its fire door, hearth, and feet, of the illuminated side door with its frame, and of the pot hole frame with its cover."

6. For *Cooking Stoves;* N. S. Vedder, Troy, Assignor to John S. and Merritt Peckham, Utica, New York.

Claim.—"The general design."

7. For *Legs and Posts of Bedsteads;* Wm. Maurer, City of N. Y.; dated March 31, 1857.

Claim.—"The posts, with scroll bars and vines, the panels with ornaments, and the legs having the leaf-scrolls, leaf-edging, and the tulip and fluted ornaments."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Notes on the Performance of the Steamer William Jenkins.

The steamers *William Jenkins* and *Joseph Whitney*, constitute a line between Baltimore and Boston, principally for freight, and have been running most successfully since they were placed on the route.

The *Jenkins* was built in Baltimore by J. A Robb, engine and boilers by Messrs. Murray & Hazlehurst, "Vulcan Works."

The *Whitney* in New York by John Englis, engine and boiler by the "Neptune Iron Works." Full particulars of these two ships will be found in the *Journal Franklin Institute* of February and March, 1855, but, for a more convenient reference, I have inserted *here* a few of the more important dimensions.

William Jenkins.	feet.
Length on deck,	205
Breadth of beam,	31
Depth of hold,	9
Immersed sectional area at 13·5 feet mean draft,	390
Tonnage C. H. M., 1000.	

J. Whitney.	feet.
Length on deck,	200
Breadth of beam,	33
Depth of hold,	9
Immersed sectional area at 13·5 feet mean draft,	390·5
Tonnage C. H. M., 1000.	

Motive Power. One top beam engine.	
Diameter of cylinder,	56½ ins.
Stroke of piston,	9 ft.
Diameter of water wheel,	26 "
Length of blades,	8 ft. 6 ins.
Depth of "	22 "
Sickels' cut-off adjustable.	

Motive Power. One top beam engine.	
Diameter of cylinder,	52 ins.
Stroke of piston,	11 ft.
Diameter of water wheel,	29 "
Length of blades,	7 ft. 6 ins.
Depth of "	18 ins.
Stevens's cut-off fixed.	

Through the kindness of Mr. A. Senifleben, I have been furnished with copies of the *William Jenkins's* steam logs, for a trip from Baltimore to Boston and back.

STEAM LOG.—*Going to Boston, December* 6, 1856.

Date, &c., Dec. 6, 1856.	Average Steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation.	Hot-well.	Average coal per hour.
P. M.										
1	22	½	25	Full.	182					
2	22	"	"	"	912	730	12·1		115°	1239·6
3	22	"	"	"	1648	736	12·2		"	"
4	22	"	"	"	2380	732	12·2		"	"
5	22	"	"	"	3112	732	12·2		"	"
6	22	"	"	"	3844	732	12·2		"	"
7	22	"	"	"	4575	731	12·1		"	"
8	23	"	"	"	5347	772	12·8		"	"
9	22	"	"	"	6360	751	12·5		"	"
10	22	"	"	"	6846	748	12·4		"	"
11	22	"	"	"	7597	751	12·5		"	"
12	22	"	"	"	8353	756	12·6		"	"
A. M.	22·08	54					12·3			1239·6

STEAM LOG.—*Going to Boston, December* 7, 1856.

Date, &c., Dec. 7, 1856.	Average Steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average Revolutions per minute.	Saturation		Hot-well.	Average coal per hour.
A. M.											
1	22	½	25	Full.	9111	788	12·6			115°	1239·6
2	23	"	"	"	9888	777	12·95			"	"
3	22	"	"	"	10645	754	12·57			"	"
4	22	"	"	"	11394	748	12·47			"	"
5	22	"	"	"	12134	740	12·3			"	"
6	22	"	"	"	12869	735	12·2	1⅜	1½	"	"
7	22	"	"	"	13570	701	11·6	"	"	"	"
8	22	"	"	"	14220	650	10·8	"	"	"	"
9	22	"	"	"	14856	636	10·6	"	"	"	"
10	22	"	"	"	15480	634	10·5	1⅝	1¾	"	"
11	22	"	"	"	16110	630	10·5	"	"	"	"
12	22	"	"	"	16798	688	11·1	"	"	"	"
P. M.											
1	22	"	"	"	17516	718	11·9	1¾	"	"	"
2	22	"	"	"	18236	720	12·	"	"	"	"
3	22	"	"	"	18968	732	12·2	"	"	"	"
4	22	"	"	"	19716	748	12·4	"	"	"	"
5	22	"	"	"	20446	730	12·1	"	"	"	"
6	22	"	"	"	21191	745	12·4	"	"	"	"
7	22	"	"	"	21953	762	12·7	"	"	"	"
8	22	"	"	"	22730	777	12·9	"	"	"	"
9	22	"	"	"	23446	716	11 9	"	"	"	"
10	22	"	"	"	24137	691	11·5	"	"	"	"
11	22	"	"	"	24795	658	10 9	"	"	"	"
12	22	"	"	"	25405	610	10·1	"	"	"	"
							11·79				
	22·04	54									1239·6

STEAM LOG.—*Going to Boston, December* 8, 1856.

Date, &c., Dec. 8, 1856.	Average Steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation		Hot-well.	Average coal per hour.
A. M.											
1	22	½	25	Full.	26022	617	10·28	1¾	1¾	115°	1239·6
2	22	"	"	"	26650	623	10·7	"	"	"	"
3	22	"	"	"	27265	620	10·6	"	"	"	"
4	23	"	"	"	27930	665	11·	"	"	"	"
5	23	"	"	"	28620	690	11·5	"	"	"	"
6	23	"	"	"	29300	680	11·3	"	"	"	"
7	21	"	"	"	29923	620	10·3	"	"	"	"
8	23	"	"	"	30643	720	12·	"	"	"	"
9	21	"	"	"	31304	661	11·	"	"	"	"
10	22	"	"	"	31984	690	11·5	"	"	"	"
11	22	"	"	"	32684	690	11·5	"	"	"	"
12	22	"	"	"	33377	693	11·5	"	"	"	"
P. M.											
1	19	"	"	"	34069	692	11·5	"	"	"	"
2	19	"	"	"	34777	708	11·8	"	"	"	"
3	21	"	"	"	35510	733	12·2	"	"	"	"
4	21	"	"	"	36237	727	12·1	"	"	"	"
5	20	"	"	"	36949	712	11·8	"	"	"	"
6	21	"	"	"	37672	723	12·	"	"	"	"
7	22	"	"	"	38424	752	12·5	"	"	"	"
8	22	"	"	"	39275	851	14·1	"	"	"	"
9	19	"	"	"	40068	793	13·2	"	"	"	"
10	22	"	"	"	40907	834	13·9	"	"	"	"
11	22	"	"	"	41752	846	14·1	"	"	"	"
12	20	"	"	"	42564	811	13·5	"	"	"	"
							11·91				
	21·04	54									1239·6

STEAM LOG.—*Going to Boston, December 9, 1856.*

Date &c., Dec. 9, 1856.	Average Steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per 4 hours.	Average revolutions per minute.	Saturation		Hot-well.	Average coal per hour.
A. M.											
1	21	½	25	Full.	43385	821	13·6	13¼	13¼	115°	1239·6
2	22	½	"	"	44230	845	14·	"	"	"	"
3	21	"	"	"	45056	826	13·7	"	"	"	"
4	22	"	"	"	45891	835	13·8	"	"	"	"
5	22	"	"	"	46724	832	13·8	"	"	"	"
6	22	"	"	"	47550	832	13·8	"	"	"	"
7	22	"	"	"	48393	837	13·9	"	"	"	"
8	23	"	"	"	49251	858	14·3	"	"	"	"
9	22	"	"	"	50059	808	13·4	"	"	"	"
10	23	"	"	"	50803	744	12·4	"	"	"	"
11	23	"	"	"	51524	721	12·	"	"	"	"
12	24	"	"	"	52217	723	12·08	"	"	"	"
P. M.											
1	24	"	"	"	52950	703	11·7	"	"	"	"
2	24	"	"	"	53650	700	11·6	"	"	"	"
3	24	"	"	"	54354	704	11·7	"	"	"	"
4	24	"	"	"	55070	716	11·9	"	"	"	"
5	24	"	"	"	55778	705	11·7	"	"	"	"
6	24	"	"	"	56907	711	11·7	"	"	"	"
7	24	"	"	"	57219	704	11·9	"	"	"	"
8	23	"	"	"	57911	699	11·6	"	"	"	"
9	22·9	54									1239·6
10											
11											
12											

Remarks.—December 6th, 1856, P. M. At 12 h. 44′ got underway from the dock at Baltimore, at one hour abreast of the "Lazaretto." Register 188 revolutions. At two hours set foresail and foretopsails, wind light and fair, at 2h. 2′ North Point light abeam. Register 956 R. At 3h. 50′ set main spencer, wind W. N. W., weather fair and a fine breeze. At 11h. 55′ passed Smith's Point light boat; register 8291 revolutions. At midnight took in main spencer.

December 7th. At 3h. 12′ passed Wolf's Trap light boat; register 10,792 revolutions. At 6h. 10′ took in all sails. At 6h. 49′ passed out by Cape Henry; register 13,400 R.; light airs, smooth sea. At 1h 45′ set jib and main spencer. At 2h. 15′ set foresail. At 3h. 5′ abreast of Chincotigue; register 19,596 R.; last part of this 24 hours some sea on and increasing.

December 8th. During first part of this 24 hours sea moderating, wind fresh from W. N. W. At 7h. 25′ set topsails and foresails. At 11 h. 6′ abreast of Montauk Point; register 41,836 R., having made from Cape Henry to this Point 28,436 R.; latter part of this 24 hours sea moderate, light breezes.

December 9th. At 12h. 30′, A. M., Block Island abeam; register 43,066 R. At 4h. 12′, P. M., Gay Head light abeam; register 46,055 R. At 4h. 54′ took in forespencer. At 6h. 41′ passed Cross Rip light boat; register 48,266 R. At 8h. 45′ took in all sails. At 8h. 45′ passed Pollock's Rip light boat; register 49,987 R.; strong head wind and tide. At 8h. 7′ come to at the wharf at Boston, having made during the run, 57,995 revolutions, and was 79·5 hours running time.

From the above log, the following averages were taken, and will be used as the basis of an investigation of the performance of that ship for the run to Boston.

Average coal consumed per hour,	1239·6 lbs.
" steam per gauge,	22·105 ins.
" cut-off,	54· ins.
" revolutions per minute,	12·18
" vacuum,	25 ins.
" temperature hot-well,	115°
" temperature feed-water, (heater,)	139°
" density of boiler water,	$1\frac{3}{4}$

The running distance from Baltimore to Boston is 666 nautical miles, and the total number of revolutions made was 57,995, time required to make the run $79\frac{1}{2}$ hours.

Boilers.—Two in number, 14 feet long, 11 feet 2 inches wide, and 13 feet high, each boiler has two furnaces, 6 feet long, 5 feet wide, two doors to a furnace.

The heated gases pass from each furnace to the back connexion, through two large flues, 21 inches diameter, 5 feet 7 inches long, and from thence through horizontal return *tubes* 4 inches external diameter, 10 feet long, (106 in each boiler,) to the smoke pipe.

Diameter of smoke pipe,	66 inches.
Height of smoke pipe from grate bars,	46 feet.
Average distance of grate bars from furnace crowns,	36 inches.
Grate surface,	120 sq. ft.
Natural draft, (excellent.)	
Fuel, bituminous coal.	
Total fire surface,	

When burning 1239·6 pounds of coal per hour, cutting off at 54 ins., making 12·18 revolutions per minute, with an average steam pressure of 22·105 lbs. per square inch, the boilers gave an evaporation of $8\frac{79}{100}$ pounds of water per pound of coal. Consuming per hour per square foot of grate surface 10·3 lbs.

The saturation was kept at $1\frac{3}{4}$, and the loss by blowing to maintain this point, was $15\frac{47}{100}$ per cent.

A heater or reservoir was fitted in the upper part of the steam chimney, and so arranged that the feed-water from the hot-well should circulate freely around it before entering the boiler, by which its temperature was increased from 24° to 30°; taking it at 24° as given in the log, and we have as the economic result, a gain of $2\frac{48}{100}$ per cent. in amount of heat, or $\frac{33}{100}$ tons of coal per diem.*

The space between the valves, and in the cylinder nozzles, added to the clearance, make 6·22 cubic feet to be filled with steam at each end of the cylinder before the commencement of the stroke, and although this steam is not a total loss, yet it is an element affecting the boilers in the abstract, and it is thought proper to consider it under this head.

In the case of the "*Jenkins*," $6\frac{22}{100}$ cubic feet is equivalent to $4\frac{28}{100}$ inches of the cylinder length, and taking 27·52 lbs. per square inch as the mean effective pressure acting on the piston for the full length of the

* This heater or reservoir was not in the original design of the machinery, but was adopted at the request of the engineer in charge, after the ship had been running for several months. I am of the opinion that a heater placed in such a position and prove very effective, would be at least, presumptive evidence of defective design in the boiler somewhere.

stroke, viz: 108 inches, the total power developed by the engine, may be represented as follows, $27{\cdot}52 \times 108 = 2972{\cdot}16$.

The effective pressure at the *end* of the stroke was 14·7 lbs., acting through $4\frac{28}{100}$ inches $= 62{\cdot}916$, which is 2·12 per cent. nearly of 2972·16; therefore, the loss of power sustained by filling the vacuities before the stroke commences, may be represented proportionally as follows, viz: $14{\cdot}7 \times 4{\cdot}28 = 62{\cdot}916$, and 62·916 being 2·12 per cent. of 2972·16, the total power, a loss of 2·12 per cent. or $9\frac{71}{100}$ horse power is the result.

Performance of Engine.

The mean performance for the run of 79·5 hours was as follows, $\frac{2507{\cdot}1 \times 27{\cdot}52 \times 219{\cdot}24}{33{,}000} = 458{\cdot}4$ H. P. developed. The distribution being as follows:

Oblique action and slip,	26·	per cent. or	119·184 H. P.
Friction of engine,	7·	"	32·08 "
" load,	4·5	"	20·628 "
Power required to work air-pump,	3·6	"	16·55 "
Leaving to be utilized in propelling the ship,	58·9	"	269·997 "
	100·0		458·439

Proportion of immersed sectional area to effective horse power, 1·4 : 1.

On the return trip, viz: from Boston to Baltimore, different results were obtained, as will be seen by inspection of the following log, and the deductions made therefrom:

STEAM LOG.—*Returning to Baltimore, December 27, 1856.*

Date, &c., Dec. 27, 1856.	Average steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation.	Hot-well.	Average coal per hour.
P. M.										
1										
2										
3										
4										
5	15	11 in	25	¾	526				115°	
6	17	"	"	Full.	1585	1057	17·6		"	1652
7	17	"	"	"	2639	1054	17·5		"	"
8	17	"	"	"	3674	1035	17·2		"	"
9	19	"	"	"	4753	1079	17·98		"	"
10	18	"	"	"	5794	1041	17·3		"	"
11	19	"	"	"	6872	1078	17·6		"	"
12	19	"	"	"	7939	1067	17·7		"	"
	17·6	11 in					17·55			1652

STEAM LOG.—*Returning to Baltimore, December* 28, 1856.

Date, &c., Dec. 28, 1856.	Average steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average Revolutions per minute.	Saturation.		Hot-well.	Average coal per hour
A. M.											
1	19	41 ins.	25	Full.	8977	1036	17·26			115°	1652
2	20	do	do	do	10017	1030	17·16			do	do
3	20	do	do	do	11036	1019	16·98			do	do
4	21	do	do	do	12080	1044	17·4			do	do
5	21	do	do	do	13132	1052	17·5			do	do
6	21	do	do	do	14180	1048	17·4			do	do
7	21	do	do	do	15212	1032	17·16			do	do
8	21	do	do	do	16292	1080	18·			do	do
9	19	do	do	do	17351	1059	17·6	1⅝	1¾	do	do
10	21	do	do	do	18471	1120	18·6	do	do	do	do
11	21	do	do	do	19574	1103	18·3	do	do	do	do
12	21	do	do	do	20678	1104	18·3	do	do	do	do
P. M.											
1	19	do	do	do	21735	1051	17·5	1¾	do	do	do
2	19	do	do	do	22828	1093	18·2	do	do	do	do
3	21	do	do	do	23961	1133	18·88	do	do	do	do
4	20	do	do	do	25087	1226	20·4	do	do	do	do
5	20	do	do	do	26194	1107	18·45	do	do	do	do
6	20	do	do	do	27331	1137	18·9	do	do	do	do
7	20	do	do	do	28476	1145	19·	do	do	do	do
8	20	do	do	do	29620	1144	19.	do	do	do	do
9	20	do	do	do	30769	1149	19·1	do	do	do	do
10	20	do	do	do	31914	1145	19·	do	do	do	do
11	20	do	do	do	33039	1125	18·7	do	do	do	do
12	21	do	do	do	34194	1155	19·	do	do	do	do
	20·25	41					18·28				1652

STEAM LOG.—*Returning to Baltimore, December* 29, 1856.

Date, &c., Dec. 29, 1856.	Average steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation.		Hot-well.	Average coal per hour.
A. M.											
1	18	41 ins.	25	Full.	35271	1077	17·9	1¾	1¾	115°	1652
2	20	do	do	do	36412	1141	19·2	do	do	do	do
3	21	do	do	do	37566	1154	19·	do	do	do	do
4	20	do	do	do	38707	1141	17·5	do	do	do	do
5	18	do	do	do	39800	1053	19·1	do	do	do	do
6	20	do	do	do	40947	1147	19·2	do	do	do	do
7	20	do	do	do	42089	1142	18·8	do	do	do	do
8	21	do	do	do	43242	1153	19·7	do	do	do	do
9	20	do	do	do	44374	1132	17·9	do	do	do	do
10	22	do	do	do	45557	1183	19·7	do	do	do	do
11	22	do	do	do	46743	1186	19·7	do	do	do	do
12	22	do	do	do	47223	1180	19·6	do	do	do	do
P. M.											
1	19	42 ins.	do	do	49024	1101	18·3	do	do	do	do
2	21	do	do	do	50184	1160	19·3	do	do	do	do
3	21	do	do	do	51358	1174	19·5	do	do	do	do
4	20	do	do	do	52415	1157	19·2	do	do	do	do
5	20	do	do	do	53590	1175	19·5	do	do	do	do
6	21	do	do	do	54778	1188	19·8	do	do	do	do
7	20	do	do	do	55933	1155	19·2	do	do	do	do
8	20	do	do	do	57089	1156	19·2	1⅛	1⅛	do	do
9	20	do	do	do	58233	1144	19·	do	do	do	do
10	21	do	do	do	59385	1152	19·2	do	do	do	do
11	22	do	do	do	60563	1178	19·6	1⅛	1⅛	do	do
12	21	44	do	do	61723	1161	19·3	do	do	do	do
		41·1/6					19·1				1652

STEAM LOG.—*Returning to Baltimore December* 30, 1856.

Date, &c., Dec. 30, 1856.	Average steam.	Cut-off.	Vacuum.	Throttle valve.	Register.	Revolutions per hour.	Average revolutions per minute.	Saturation.		Hot-well.	Average coal per hour.
A. M.											
1	19	44 ins.	25 ins.	Full.	62846	1113	18·5	1½	1½	115°	1652
2	20	"	"	"	64012	1166	19·4	"	"	"	"
3	20	"	"	"	65172	1160	19·3	"	"	"	"
4	20	"	"	"	66326	1154	19·	"	"	"	"
5	17	"	"	"	67400	1074	17·9	"	"	"	"
6											
	19·2	44 ins.					18·8				1652

Remarks.—December 27, at 2h. 10′, P. M., started fires; had steam at 3h. 45′, and at 4 h. 29′ left the wharf. At 5h. 12′ passed the Boston light, wind and tide fair; register showing 740 revolutions. At 6h. 25′ set topsails. At 9h. 7′ Cape Cod light abeam; register 4865 revolutions. At 10h. 17′ Nauset light abeam; register 6088 R. At 11h. 35′ Chatham light abeam; register 7502 R., wind light, smooth sea.

December 28. At 12h. 15′ took in topsails. At 12h. 30′ passed Pollock's Rip light boat; register 8443 R. At 2h. 11′ abreast of Cross Rip light boat; register 10,201 R. At 3h. 39′ Holmes' Hole; register 10,860 R. At 4h. 44′ Gay Head light, register 12,854 R. At 7h. 25′ set fore and main spencer, smooth sea, light airs. At 3h. P. M. took in all sails.

December 29, A. M. This day commences with light winds ahead, and smooth sea. At 6h. A. M., set fore and main sails. At 9h. took in all sails, wind light and smooth sea the remainder of the day.

December 30, A. M. At 12h. 47′ abreast of Sharp's Island. At 3h. 20′ slowed engine. At 4h. 29′ North Point abeam, light airs, smooth sea; register 66,893 R. At 5h. 40′ came to at the dock; having made from Boston to Baltimore, 68,022 revolutions, 61 hours running time.

The average results obtained from this log, are as follows; and, as in the former case, will constitute the basis of the investigation for the return trip.

Average coal consumed per hour,	1652 lbs.
" steam per gauge,	19 36 ins.
" cut-off,	41·71 ins.
" revolutions per minute,	18·43
" vacuum,	25 ins.
" temperature of hot-well,	115°
" " feed water, (heated,)	139°
" density of boiler water,	1¾

The running distance, as before stated, is 666 nautical miles. Total number of revolutions made, 68,022. Running time 61 hours.

Boilers.—Burning 1652 pounds of coal with an average steam pressure

of 19·36 lbs. per square inch, and cutting off at 41·7 inches, the evaporation was as follows, $\frac{66{\cdot}72 \times 36{\cdot}86}{788} = 3{\cdot}12$ and $\frac{3{\cdot}12 \times 60 \times 64{\cdot}3}{1652} = 7{\cdot}3$ lbs. of water evaporated to the pound of coal.

Loss from blowing off at $1\frac{3}{4}$, .	15·02 per cent.
Gain by heater, 2·5 per cent. or	$\frac{44}{100}$ tons of coal.
Coal consumed per hour per square foot of grate, . .	13·7 lbs.

Performance of Engine.—The mean performance for the run of 61 hours was as follows:

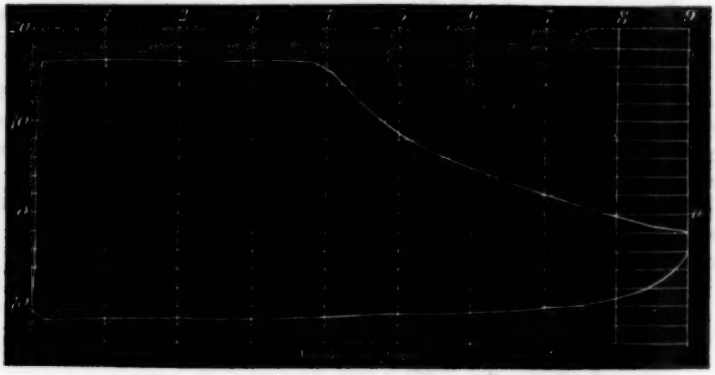
$\frac{2507{\cdot}1 \times 21{\cdot}8 \times 331{\cdot}74}{33000} = 549{\cdot}43$ total developed power, the distribution being as follows:

Oblique action and slip, .	31·19 per cent. or	171·36 H. P.	
Friction of engine, . . .	5·00	"	27·47 "
" load, . .	4·60	"	25·07 "
Power required to work air pump, .	4·50	"	24·72 "
Leaving to be utilized in propelling the ship,	54·71	"	300·58 "
	100·00	"	549·20

Proportion of immersed sectional area to effective horse power, 1·09 to 1.

The following diagram will show the working condition of the engine.

Steam 19½. Revolutions 18. Vacuum 26. Hot-well 115°.



A Brown Ink for Marking Linen.[*]

The solution for writing consists of ½ an ounce of acetate of manganese in 1½ ozs. of water: the linen is prepared by saturation with a solution of 1 drm. of prussiate of potash, stiffened with 1½ drms. of gum-arabic, drying and ironing.—*Würzb. Wochenschrift*, 1855, No. 10.

[*] From the Lond. Chem. Gaz., No. 320.

For the Journal of the Franklin Institute.

Particulars of the Steamer Eastern Queen.

Hull built by John Englis, New York. Machinery by Morgan Iron Works, New York. Owners, Captain Kemble and others. Intended service, Boston to Gardiner.

HULL.—

Length on deck,	220 feet.
Breadth of beam, (molded,)	29 "
Depth of hold to spar deck,	11 " 3 inches.
" keel,	6 "
Tonnage,	700.
Area of immersed section at load draft,	173 sq. feet.
Contents of bunkers in tons of coal,	150.
Masts—two—Rig—schooner.	

ENGINES.—Vertical beam.—

Diameter of cylinder,	48 inches.
Length of stroke,	11 feet.
Cut-off, at one-half.	

BOILER.—One—Return flued.—

Length of boiler,	28 feet.
Breadth "	12 " 6 inches.
Height " exclusive of steam chimney,	11 "
Number of furnaces, 3.	
Diameter of shell,	10 "
Length of grate bars,	7 " 2 "
Number of flues, above 5—below 10.	
Internal diameter of flues above,	18½ "
" " below, six,	13 "
" " below, ten,	12 "
" " below, ten,	18 "
Diameter of smoke pipe,	4 feet 6 inches.
Height "	32 "

PADDLE WHEELS.—

Diameter over boards,	30 "
Length of blades,	8 "
Depth "	2 " 2 "
Number, 26.	

Remarks.—Frames *molded* 14 ins; *sided* 6 and 7 ins.; 24 ins. apart from centres, and strapped with diagonal double laid braces $4 \times \frac{1}{2}$ inch. Blowers to furnaces. C. H. H.

For the Journal of the Franklin Institute.

Comparative Results attained by Rising Flue Boilers and Martin's Vertical Tubular Boilers in the U. S. Steamer Susquehanna.

The following data, compiled carefully from the logs of the abovenamed steamer, have been furnished us from a reliable source, and are interesting as showing the economic gain in the use of well designed vertical tubular boilers. To appreciate the whole gain by the latter, the great saving of space from that occupied by the old form of boiler ought not to be overlooked. Particulars of both sets of boilers have previously appeared in this *Journal*.

Summary of Abstracts of the Steam Logs of the U. S. Steamer Susquehanna. From June 1st, 1851, to March 31st, 1855—WITH OLD BOILERS.

Total time		Steam alone.		Steam & Sail.		Sail alone.		Average pressure of steam.	Average revolutions per minute.	Aver'ge speed per hr. knots	Aver'ge coal consumed per hour.	Total coal consumed tons.	Total distance run.	Dist'nce with sail alone.	Dist'ce with steam alone and steam & sail.
Days.	Hrs.	Days.	Hours.	Days.	Hours	Days.	Hrs.								
								lbs.			lbs.				
337	5	194	2	131	4	11	23	9·1	10	7·25	3362	11·000	61,129	2251	58878

From May 1st to September 30th, 1856—WITH NEW BOILERS.

From May 1st to July 31st.

44	15	19	11	15	1			11·4	11·3	8·3	2595	1·404	8715		8715

From August 5th to September 30th. Frigate Congress in tow.

8	4	84						11·2	11	6·5	2860	318	1248		1248

Total average with "new boilers."

52	19	37	18	15	1			11·35	11·25	8	2752	1722	9963		9963

By reducing these abstracts to one common standard of speed, by means of the ordinary rules applied for that purpose, with the view of obtaining the relative economy of fuel, and by taking the "logs" of the ship with "old boilers" as the basis of calculation, having special reference to speed and coals, we obtain the following comparative results:

The performances of the ship under ordinary circumstances, (with the ship alone,) is found to be as 100 : 182, or 45 per centum in favor of the new boilers.

With the Frigate *Congress* in tow, it was as 100 : 87, or an expenditure of only 13 per cent. more fuel whilst the ship was performing double duty.

A general mean of performances with "new boilers," is as 100 : 134, or 25 per cent. in their favor under all circumstances (including time of towing, &c.)

*The Atlantic Submarine Cable.**

The projected telegraphic communication between this country and the United States is of such vast importance, that any suggestions tending to its successful completion are worthy the consideration of the directors of the scheme.

The object of this letter is to draw attention to the probable effect of the immense pressure to which the insulated wire will be exposed when sunk in the Atlantic. Supposing the gutta percha coating to be perfect, no injury can be sustained by this pressure; but in case of there being any "*blows*" (air holes) that have merely a skin of gutta percha over them, the water under so enormous a pressure would soon find its way to the wire and destroy the insulation, and so render the cable useless. These defects would not be perceived by ordinary testing, such as immersing the cable in a few feet of water.

The plan of testing I should propose, is to construct large cast iron

* From the Practical Mechanic's Journal, Feb., 1857.

tanks in which some hundred miles of cable can be placed, with stuffing boxes where the wire enters and leaves the vessel, and then subjecting it to hydrostatic pressure; the insulated wire to be connected through a galvanometer with one pole of a powerful intensity battery, and the iron of the tank, in which the cable is enclosed, with the opposite pole.

Chester, January, 1857. J. H.

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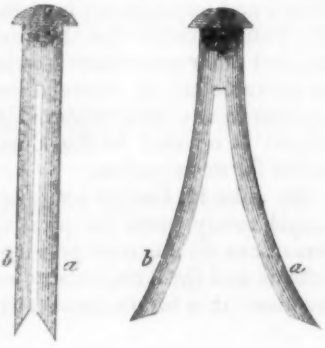
*Westley's Expanding Spikes.**

Mr. William Westley, of Wellington, Derby, has patented the improved nail or spike shown in the annexed engravings. The body of the nail or spike is split into two legs or fangs, *a b*, fig. 1, which are chamfered or beveled at their ends, the said beveled ends constituting two edges, the inclined faces of which are turned towards each other. In driving the nail or spike into wood or other substance, the wedge-shaped ends, in consequence of their inclined faces being turned towards each other, cause the two halves, *a b*, to open, in the manner represented in fig. 2, and thus fix themselves firmly in the material.



* From the Lond. Mech. Mag., Nov., 1856.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, April 16th, 1857.

John Agnew, Vice President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

Letters were read from the K. K. Geological Society, Vienna; Smithsonian Institute and the Metropolitan Mechanics' Institute, Washington City, D. C.

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